

The Saltonstall-Kennedy Grant Program: Fisheries Research and Development

ANNOTATED BIBLIOGRAPHY

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National Marine Fisheries Service

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INTRODUCTION

Under the Saltonstall-Kennedy (S-K) Act, as amended, grants and cooperative agreements are awarded by the National Marine Fisheries Service to assist in carrying out research and development projects related to the U.S. commercial and recreational fishing industry. Research has been supported by the Act to resolve problems associated with the harvesting, processing, and marketing of fish and fish products.

This annotated Bibliography provides information on project reports or products prepared under the S-K Program. In some cases, there is a charge for the reports. The reports are the products of S-K grant recipients and do not necessarily represent the views of the National Marine Fisheries Service.

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PROJECT ABSTRACTS

GRANT NUMBER: NA89ABH00016 NMFS NUMBER: 88-AKR-003
REPORT TITLE: The Role of Pacific Groundfish in International
Groundfish Trade
AUTHOR: Johnson, Richard S.
PUBLISH DATE: September 29, 1990
AVAILABLE FROM: National Marine Fisheries Service
Alaska Region
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ABSTRACT

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The objective of this project was to assess the competitive position of the U.S. groundfish industry in global groundfish markets, considering the costs of harvesting, processing, and marketing groundfish products; the nature of the demand for those groundfish products; the nature of supply from competing sources of groundfish products; and, the nature of institutional arrangements, including government policy here and abroad. An economic model was developed to depict the "internationalization" of the world groundfish market. Based on the model, the researchers concluded that extended fisheries jurisdiction, while having little impact on landings and ex-vessel prices, has played an important role in international groundfish trade.

GRANT NUMBER: NA90AAHSK068 NMFS NUMBER: 90-NWR-030
REPORT TITLE: Salmon Farming Health Management Program
AUTHOR: Battelle Marine Sciences Lab., Sequim, WA; Texas
A&M University, College Station, TX; Oregon
State University, Corvallis, OR; Bellwether
Consulting, Quilcene, WA
PUBLISH DATE: March 22, 1995
AVAILABLE FROM: National Marine Fisheries Service
Northwest Regional Office
7600 Sand Point Way, NE
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ABSTRACT

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In conclusion, the development of veterinary externships at a marine laboratory in conjunction with veterinary schools was an extremely useful training mechanism. The losses of fish to diseases and environmental conditions can be reduced by reduction or elimination of diseases in the freshwater phase of culture, avoiding the transfer of infected brood stock to the freshwater site, use of appropriate vaccines, use of chemotherapeutants where appropriate, and improved management of stock density, handling, and feeding in seawater. Further studies are needed on conditions such as toxic hepatopathy, algal toxins, and algae producing toxic effects in fish. Studies are needed to develop a vaccine for the prevention of ulcerative stomatitis. Bacterial kidney disease free stocks of fish would further increase productivity. Surveillance of fish health in both freshwater and seawater is needed as well as management of smolt quality. Many of these recommendations for improvements have been implemented since this study was completed resulting in greatly increased productivity of fish farming in Puget Sound, Washington.

GRANT NUMBER: NA90AAHSK145 NMFS NUMBER: 90-SER-013
REPORT TITLE: Evaluation of Trawl Bycatch Impact High Level
Carnivores in the Pelagic Environment of the
Western Gulf of Mexico
AUTHOR: Anderson, Wilma
PUBLISH DATE: September 3, 1996
AVAILABLE FROM: National Marine Fisheries Service
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PHONE: (813) 570-5324

ABSTRACT

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This project identified and quantified shrimp harvesting catch areas frequented by the Texas Gulf shrimp fishing fleet; evaluated recreational fishing success in the area of shrimp bycatch discharge; and described the vertical distribution of pelagic species feeding on the shrimp fleet bycatch discard. The project attempted to reduce user conflict over the bycatch issue between the commercial shrimp fleet and recreational community. The researchers provided an accurate summary of bycatch in areas of recreational interest, and evaluated impacts of commercial shrimping activities on species targeted by recreational fisherman.

GRANT NUMBER: NA90AAHSK151 NMFS NUMBER: 89-SWR-075
REPORT TITLE: Can Submerged Lights Enhance the Effectiveness
of Fish Aggregation Devices
AUTHOR: Amesbury, Steven S. and Ker, Alexander M.
PUBLISH DATE: May 1, 1995
AVAILABLE FROM: National Marine Fisheries Service, NOAA
Southwest Region
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Long Beach, CA 90802-4213
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ABSTRACT

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The objective of this project was to determine whether submerged lights would enhance the effectiveness of Fish Aggregating Devices (FADs). A series of tests showed no clear indication that the lights enhanced the effectiveness of the FADs. Although *Selar crumenophthalmus* (bigeye scad) were caught around FADs with lights but not around FADs without lights, there were so many instances of these fish not being caught around either lighted or unlighted FADs that there was no demonstrable statistically significant effect.

GRANT NUMBER: NA90AAHSK165 NMFS NUMBER: 89-AKR-010A
REPORT TITLE: By-Product Utilization of Non-Fillet
Flesh from Alaska Fisheries
AUTHOR: McFarland, Rae; Clark, Stephen; Middleton, Jack;
Crapo, Chuck; Himelbloom, Brian H. and
Ogden, Lynn V.
PUBLISH DATE: February 01, 1992
AVAILABLE FROM: National Marine Fisheries Service, NOAA
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ABSTRACT

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This project included three phases: primary product processing, secondary product development and processing, and market investigation and introduction. All phases were successfully completed during the course of eighteen months of effort. Primary production of mince from frames was completed with evaluations of the product conducted by a laboratory and various customers. Three secondary products were developed and evaluated through a focus group. One final product was test marketed with in-store demonstrations and fully developed point-of-sale material. In conclusion, increased recovery in Alaska groundfish processing is feasible through the use of frame mince. The contents of this report include: A primary product production report; product process diagram; product customer comments; quality and stability of primary product; focus group evaluation of three secondary products, and a market introduction of shrimp patties.

GRANT NUMBER: NA90AAHSK165 NMFS NUMBER: 89-AKR-010B
REPORT TITLE: The Recovery of Non-Fillet Flesh from Frames
and Bone and Parasite Removal Technology
Development
AUTHOR: Alaska Fisheries Development Foundation
PUBLISH DATE: May 1, 1995
AVAILABLE FROM: National Marine Fisheries Service
Alaska Region
P.O. Box 21668
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ABSTRACT

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Alaska Fisheries Development Foundation continued efforts to fully utilize Alaska's groundfish resources. Two tasks were incorporated into the project: The first was the investigation of the use of groundfish frames to produce a high quality protein raw material for the food industry; and secondly to complete an ongoing project to develop a machine vision system to detect groundfish bones and parasites during the manufacture of fillets.

The objective of this project was to continue research to recover additional usable fish flesh from filleted groundfish carcasses, and develop and test improved techniques for detecting bones and parasites in groundfish fillets. A system was to be developed and tested which can segregate defective product while allowing defect-free product to pass without being handled. The non-fillet flesh recovery portion of the project was successful and resulted in the sale of some non-fillet flesh volumes which would have gone directly to the waste stream. The raw material extraction was successful and both yields and quality were improved during the course of the project. The bone and parasite removal portion of the project was not successful from the standpoint of answering industry problems. The new detection technique continues to show promise on a research level and the process has been patented by the University of Alaska Fairbanks. During the by-product utilization portion of the project, primary production of mince from frames was completed with evaluations of the product conducted by a laboratory and various customers. Three secondary products were developed and evaluated through a focus group. One final product was test marketed within-store demonstrations and fully developed point-of-sale material. Increased recovery in Alaska groundfish processing is feasible through the use of frame mince. For high volume groundfish processors this increased recovery seems to be sound from an economic perspective.

GRANT NUMBER: NA90AAHSK237 NMFS NUMBER: 90-SWR-051
REPORT TITLE: Sea Cucumber Fishery Development in
Micronesia - Year 3
AUTHOR: Richmond, Robert H.
PUBLISH DATE: August 4, 1994
AVAILABLE FROM: National Marine Fisheries Service, NOAA
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ABSTRACT

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This study of the reproductive and population biology of three commercially valuable species of sea cucumbers was undertaken to support the development of a sustainable fishery for Micronesia. The species *Holothuria (Microthele) nobilis*, *Actinopyga mauritiana*, and *Thelenota ananas* were chosen for their high market values and presence throughout the region. The first year of this multi-year program included field surveys, experiments on tagging techniques, determination of reproductive timing, and initial steps of larval rearing. Year two of the research program concentrated on refinement of larval rearing techniques, continuation of the database on reproductive timing, and expansion into the areas of population biology and natural products chemistry.

GRANT NUMBER: NA90AAHSK680 NMFS NUMBER: 89-AKR-003
REPORT TITLE: Augmented Roe Production
AUTHOR: Smoker, William W. and Crandell, Patricia A.
PUBLISH DATE: May 15, 1995
AVAILABLE FROM: National Marine Fisheries Service
Alaska Region
P.O. Box 21668
Juneau, AK 99802
PHONE: (907) 586-7224

ABSTRACT

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The objective of this project was to augment roe production in pink salmon hatcheries by applying gynogenesis and masculinization to brood stocks to develop all-female milt for fertilizing hatchery-reared eggs, thereby producing all female offspring. This project applied practical fish gender-control technology to Pacific salmon. Successful control of salmon gender on a production scale requires application of two procedures, namely, gynogenesis and sex reversal. This project had good success in applying gynogenesis techniques to Pacific salmon, in particular pink salmon (*Oncorhynchus gorbuscha*) and coho salmon (*O. kisutch*). The project had minimal success in applying sex reversal techniques to pink salmon but provided a basis for ongoing development of more successful techniques after the end of the project.

GRANT NUMBER: NA16FL0068 NMFS NUMBER: 90-NER-010
REPORT TITLE: Assessment of Juvenile Bycatch Survivability in
the Northeast Fishing Industry
AUTHOR: Robinson, William E. and Carr, H. Arnold
PUBLISH DATE: May 11, 1993
AVAILABLE FROM: National Marine Fisheries Service
Northeast Region
One Blackburn Drive
Gloucester, MA 01930-2298
PHONE: (508) 281-9256

ABSTRACT

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The objective of this project was to assess the juvenile bycatch survivability of cod and other important groundfish species. Survival data was collected on three bottom-dwelling species, one gadoid (Atlantic cod) and two flatfish (American plaice and yellowtail flounder). Yellowtail flounder exhibited the greatest resistance to fishing induced stress. Plaice were intermediate in survivability, with Atlantic cod being the most susceptible to fishing-induced mortality. Cod and plaice experienced lower mortality during the April survey than during the June survey, indicating that the higher surface water and air temperatures, and/or differences in other environmental parameters during the warmer summer months may have a profound effect on survival. The nonparametric statistics used in this study to determine the degree to which the various environmental factors affect survivability indicated that cod survival was influenced by air temperature, deck time, fish length, tow duration and tow weight, whereas plaice survival was impacted by air temperature and deck time. The ability of these nonparametric statistics to detect relationships depended heavily on adequate sample size, which was not always present. The information gathered during this investigation provides a strong basis to determine actual survival of cod, plaice and yellowtail during different seasons. Indications are that the cod-end escapees of the three species had high survival rates (>91 percent). This high survival rate supports the concept of conservation by using selective trawl gear that will release juvenile groundfish.

GRANT NUMBER: NA16FD0206-01 NMFS NUMBER: 90-SWR-063
REPORT TITLE: Sea Cucumber Fishery Development in
Micronesia - Year 4
AUTHOR: Richmond, Robert H. and Martinez, Priscilla
PUBLISH DATE: July 19, 1995
AVAILABLE FROM: National Marine Fisheries Service
Southwest Region
501 West Ocean Blvd., Suite 4200
Long Beach, CA 90802-4213
PHONE: (562) 980-4030

ABSTRACT

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This project was the fourth year of a reproductive and population biology study using three commercially valuable species of sea cucumbers to support the development of a sustainable fishery for Micronesia. The objective was to develop the methodology to raise larvae through to the juvenile stage. The results of the previous three years' research led to the conclusion that successful management of the sea cucumber resource would be greatly enhanced by the ability to cultivate the economically valuable species. As the research progressed, it became evident that larval rearing was the most problematic aspect of the project. Prior research allowed researchers to accurately predict spawning events, collect gametes, fertilize eggs, and cultivate larvae. The ability to raise sea cucumbers through a complete life cycle was hypothesized to depend on larval nutrition and/or specific metamorphic inducers/substratum characteristics.

GRANT NUMBER: NA17FD0243-01 NMFS NUMBER: SWR-054
REPORT TITLE: Fabrication and Deployment of Fish Aggregation
Devices
AUTHOR: Aldan, David T. and Seman, Richard B.;
Commonwealth of Northern Mariana Islands,
Department of Land and Natural Resources,
Division of Fish and Wildlife, Saipan, MP
PUBLISH DATE: May 1995
AVAILABLE FROM: National Marine Fisheries Service
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ABSTRACT

A rapidly increasing local population and an expanding tourist industry increased demand for fresh fish and fishery products in the CNMI in the early 1990s. This growth in fish consumption created substantial demand for tuna and other migratory pelagic fishes (i.e., wahoo, mahimahi, and billfishes). While inshore fisheries showed signs of over harvest, offshore pelagics were believed underutilized. In the CNMI, fishing is conducted from small boats with limited fuel capacity and restricted overall range. Fishermen travel offshore to harvest fish, normally by trolling or chasing fast-moving schools. This type of fishing is relatively inefficient requiring substantial fuel. Given the lack of mid-sized or large offshore commercial pelagic fishing vessels, it was perceived the small boat fleet needed enhancement to have even the slightest chance of commercial viability. FADs provided one possible enhancement method.

In 1990, the CNMI DFW received S-K support for a project with the overall goal of developing a system of FADs in CNMI waters. The specific objectives were purchasing, assembling, deploying, and evaluating an improved FAD design (similar to that utilized in Hawaii). The DFW had previously purchased the line and hardware for eight FAD systems but lacked the resources to purchase buoys and pay for actual system deployments. Also the grant provided training for DFW staff on FAD deployment through a cooperative agreement with the State of Hawaii's DLNR.

Because of limited staffing at the DFW, activity began in earnest in the first quarter of 1992 with the purchase of eight buoys from a local surplus yard in Hawaii. The used steel buoys were refurbished and modified in Hawaii to emulate the standard design of the Hawaii FAD buoys, shipped to Saipan, and the systems were assembled. In the interim, all planned FAD sites were surveyed for appropriate bottom configuration and placement. Actual FAD deployments took place in August 1993. Almost immediately the FADs began to produce increased catches of mahimahi, skip jack, and small yellowfin tuna according to sources at the DFW.

GRANT NUMBER: NA17FD0243-01 (Cont'd.)

Individuals at the DFW attributed the FADs as being responsible for a substantial portion of the increased pelagic catch that occurred in early 1994. Fishermen also report the FADs "held the fish longer" allowing increased exploitation for a longer period of time (mahimahi tends to be seasonal in the CNMI). Beyond the purely commercial fishers the local sport charter boat fleet appears to benefit with increased success rates on trips. With the FADs local sport charter captains were assured of at least catching a skipjack or mahimahi for the predominantly Japanese clientele. This allowed the customer to partake in a "self-caught sashimi dish" (typically prepared onboard the charter vessel) leading to higher rates of customer satisfaction (consumer surplus).

Despite the fact the project ran for 24 months, it is concluded that administratively the project was *successfully* implemented, and all of the original project objectives were *successfully* obtained. Total projects cost's were \$81,692 of which \$28,289 were identified as direct expenses. The project's total cost figure does not include any documented in-kind services; however, it is believed that the recipient provided some in-kind resources. Based on commercial catch rates and usage by recreational fishers, the NPV of the project is \$3,360 with a B/C ratio of 1.04. The low return is in part attributed to the relatively short life of the FADs deployed.

GRANT NUMBER: NA26FD0126-01 NMFS NUMBER: 91-AKR-006
REPORT TITLE: Full Scale Demo of the Harvesting/Processing of
Arrowtooth Flounder
AUTHOR: Dr. Ming Wu, Dr. Jerry Babbitt, Dr. Tyre Lanier
PUBLISH DATE: October 25, 1996 Revised December 3, 1996
AVAILABLE FROM: National Marine Fisheries Service
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ABSTRACT

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The objective of this project was to develop production levels of surimi from Arrowtooth flounder, monitor changes in the quality of the surimi over time, and test the acceptance of surimi by firms that manufacture finished products from surimi. Arrowtooth flounder can be harvested, processed and transported to the consumer without softening, if no temperature abuse occurs. However, it contains endogenous protease(s) that cause the flesh, when not cooked correctly, to turn into an unappetizing mush. Researchers have developed several methods for dealing with the protease problem including the removal of the majority of the protease(s) by multiple water washes, cooking processes that rapidly transit the narrow temperature window of protease activity, and the use of protease(s) inhibitors, etc. The goals of this project were to (1) evaluate the traditional surimi processing system and its usefulness in resolving the flesh softening enigma found in Arrowtooth flounder; (2) to test the use of various protease inhibitors in the manufacture of surimi in an attempt to eliminate this problem; (3) to produce commercial volumes of Arrowtooth flounder surimi; and, (4) to obtain "user" evaluation of Arrowtooth flounder surimi for use in the manufacturing of surimi-based analog products. The researchers managed to manufacture a usable surimi product from Arrowtooth flounder which was comparable to Alaska pollack A grade. The approach and evaluation of test batches suggested that both beef plasma protein and a potato-derived inhibitor were moderately effective and resulted in a surimi, from which was believed, crab analogs could be manufactured. The project was successful in uncovering and proving a method of surimi manufacture and use that rendered inactive the endogenous protease(s) contained in Arrowtooth flounder flesh.

GRANT NUMBER: NA26FD0139 NMFS NUMBER: 91-NWR-005
REPORT TITLE: Determination of Natural Antioxidant from Shrimp
Wastes
AUTHOR: Morrissey, Michael T.; Oregon State University
PUBLISH DATE: October 6, 1994
AVAILABLE FROM: National Marine Fisheries Service
7600 Sand Point Way, NE
Seattle, WA 98115-0070
PHONE: (206) 526-6115

ABSTRACT

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A natural antioxidant was extracted with ethanol from shrimp (*Pandalus jordani*) waste samples. Purification of the antioxidant was accomplished with thin layer and high performance liquid chromatography. Purified samples were analyzed with a combination of techniques including Fourier transformed-infrared spectrometry, mass spectrometry (EI and CI), and proton nuclear magnetic resonance. The antioxidant is a polar monohydroxyl phenolic compound with ortho-position substitution and a molecular weight of 164. Crude and purified extracts were tested for preventing lipid oxidation of in fatty fish mince and retaining color in red-skinned rockfish. Both tests demonstrated practical applications for the antioxidant for inhibiting oxidation reactions in susceptible seafood products.

GRANT NUMBER: NA26FD0154 NMFS NUMBER: 91-AKR-004
REPORT TITLE: Management of Incidental Catch of Crab, Halibut,
Herring and Salmon in the Groundfish Fisheries
Off Alaska
AUTHOR: University of Alaska Anchorage, Institute of
Social and Economic Research
PUBLISH DATE: November 12, 1997
AVAILABLE FROM: National Marine Fisheries Service
Alaska Region
709 W. 9th Street, 4th Floor
P.O. Box 21668
Juneau, AK 99801
PHONE: (907) 586-7224

ABSTRACT

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The project demonstrated a new approach to modeling incidental harvest (bycatch) of the North Pacific groundfish fleet using a spreadsheet-based optimization model. The approach models industry decisions as the pursuit of profit-maximization by exploiting a mixed-stock common property fishery under total allowable catch regulations for both target species and incidental harvest. Trial simulations with a small-scale version of the model suggest that the approach realistically portrays the behavior of the fleet and the implications of bycatch management choices. An interactive user interface constructed for the model guides users through the assumptions and options of the model, making them transparent to the user.

GRANT NUMBER: NA26FD0157-01 NMFS NUMBER: 91-AKR-015
REPORT TITLE: Genetic Stock Identification of
Alaska Chinook Salmon
AUTHOR: Seeb, Lisa W.; Crane, Penelope and
Templin, William
PUBLISH DATE: June 1, 1995
AVAILABLE FROM: National Marine Fisheries Service
Alaska Region
P.O. Box 21668
Juneau, AK 99802
PHONE: (907) 586-7224

ABSTRACT

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The objective of this project was to extend existing allozyme data baseline for Alaskan chinook salmon, contribute these data to the coastwide chinook salmon database, and evaluate the feasibility of using these data to determine the origins of chinook salmon accidentally caught in groundfish trawls. A genetic analysis was completed on 22 of 47 populations sampled. Based on heterogeneity and distance analyses, at least four unique genetic lineages were identified: Southeast Alaska, Chilkat River, Southcentral Alaska, and Northwest Alaska. Mixed-stock analysis using genetic data has been successfully used to identify stock components of chinook salmon mixtures in Washington and British Columbia and may be an ideal tool for identifying stock origin of by-caught chinook salmon in Alaskan waters. The data collected in this study can be used to accurately identify the contribution of Alaskan populations in by-catch or other high seas samples.

GRANT NUMBER: NA26FD0241-01 NMFS NUMBER: 91-SWR-053
REPORT TITLE: Regional Management Plan for Sea Cucumber in
Micronesia
AUTHOR: Richmond, Robert; University of Guam Marine
Laboratory
PUBLISH DATE: November 1996
AVAILABLE FROM: National Marine Fisheries Service
Southwest Regional Office
501 West Ocean Boulevard, Suite 4200
Long Beach, CA 90802-4018
PHONE: (562) 980-4033

ABSTRACT

Dried sea cucumbers can provide significant export earnings for Pacific island states. There are 10 to 15 species of holothurians of commercial value to the bêche-de-mer trade. Despite the industry's long recorded history (pre-1700), several factors have limited the stable development of this potentially lucrative trade in places such as Fiji, Papua New Guinea, and the Solomon Islands. These factors include limited resource susceptible to over-exploitation, often resulting in destruction of the resource, poor prices paid to primary producers, transport difficulties and local unfamiliarity with correct production methods, resulting in below standard quality and poor demand.

In 1987, the PFDF and the UOG ML initiated project activities with the goal of investigating the sustainable development of sea cucumber fisheries in Micronesia and determine its mariculture potential. The project objectives were to provide data on naturally occurring stocks of sea cucumber and investigate/develop culture techniques of selected sea cucumber species for augmenting natural stocks via mariculture. Studies included basic biological research related to determining proper management strategies. Natural product studies, product processing, and marketing techniques were also to be explored. Education of Micronesian students and labor sources was emphasized for eventual technology transfer to island economies. Research was centered at the UOG ML and went on for almost seven years.

The PFDF was the primary recipient for the first three years of the study, but the last two awards went directly to the UOG ML. The project was transferred from the PFDF to UOG on the Foundation's closure and activities were also disrupted twice by typhoons which destroyed experiments. Research centered on three species of cucumbers, *Holothuria nobilis*, *Actinopyga mauritiana*, and *Thelenota ananas*. Resource surveys were completed in Palau, Guam, Saipan, and the FSM (Kosrae, Chuuk, Pohnpei). Data collected indicate these animals are limited by poor recruitment success, and natural stocks are easily overfished. Activity eventually concentrated on larval rearing activities. GRANT

NUMBER: NA26FD0241-01 (Cont'd.)

Experiments focused at varying the diets and substrates of the juvenile cucumbers and revealed for the first time the final steps of larval development, thereby closing the life cycle of two of the three species. Research resulted in regularly producing *Holothuria nobilis* and *Actinopyga mauritiana* to the pentactula stage, but *Thelenota ananas* only went as far as the doloaria stage. Experiments suggested that monocultures of algae are insufficient to provide the larval stages of sea cucumber sufficient energy resources for complete development. Ranging experiments using tag and recapture methods indicate these animals to be sessile with limited movements. Sufficient biological data was collected to convene a three-day workshop, focusing in the creation of a model sea cucumber management plan (the first for Micronesia). The workshop, which brought together most of the U.S.-affiliated States chief fishery officers allowed the dissemination of the biological data and the formulation of a management plan for developing sea cucumber resources on a sustainable basis. The plan developed is generic in nature but allows each specific site in Micronesia to consider options from a menu of possibilities. The plan also includes economic information and provides the basis for a data collection program.

This project ran for five awards (the greatest number approved for any western Pacific-based initiative). While no particular award's scope was modified per se, the project did evolve from what was initially an initiative to investigate mariculture potential to one in which the sustainable management of existing natural populations became the main project goal. Administratively while there were many disruptions, awards ran 21 months on average, and each award's final report was typically submitted late. The project is rated as *marginally successful* regarding administrative matters. Most of the project objectives were obtained and the project is rated operationally *successful*, (with exception of developing mariculture techniques for tropical holothurians). This objective appears to be particularly elusive. Recently ICLARM has begun the first 5 of a 15-year research initiative to explore the mariculture potential of this group of animals.

The total project costs were \$534,108 of which \$247,915 went to direct costs. The total project costs include \$42,144 of in-kind, with the balance going to the indirect costs of the PFDF or UOG ML and S-K administration program costs (the later IS estimated alone at \$161,415 for the five awards). No quantitative benefits could be identified; therefore, an NPV or B/C calculation proved impossible. There are, however, several qualitative benefits that should be noted:

1. The project resulted in the development of a generic sea cucumber Management Plan for Micronesian states.

NUMBER: NA26FD0241-01 (Cont'd.)

The plan allowed SPC personnel to advise resource managers in Fiji and Papua New Guinea on sustainable resource extraction rates. The PI provided advice to Ecuadorian officials for better management of the Galapagos sea cucumber fishery.

2. Information on the basic biology of the sea cucumber was determined. This information is detailed in several master's theses and a number of publications including primary literature journals.
3. At least three Micronesians were trained in sea cucumber biology, one at postgraduate level.
4. A general moratorium on export harvests in Palau and portions of the FSM has been instituted because of the need to use pre-cautionary management principles in view of the lack of mariculture alternatives.

GRANT NUMBER: NA26FD0448 NMFS NUMBER: 91-NWR-030
REPORT TITLE: Salmon Farm Health Management Project
AUTHOR: Elston, Ralph A.; Frelief, Paul F.; Heidel,
Jerry R. and Pitts, John L.
PUBLISH DATE: March 22, 1995
AVAILABLE FROM: National Marine Fisheries Service, NOAA
Northwest Region
7600 Sand Point Way, NE
BIN C15700, Bldg. 1
Seattle, WA 98115
PHONE: (206) 526-6117

ABSTRACT

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The purpose of the study was to increase the national productivity and product quality of farmed salmon through effective salmon health management. Researchers sampled over 1800 farmed salmon and trout over three years at a number of marine farm sites in Washington State. Necropsies were conducted on sampled fish and tissues preserved for histological analysis. In addition, virological, bacteriological, and other analyses were performed. Mortality data was collected at selected sites. Furunculosis was considered the most important disease of Atlantic salmon in seawater. The incidence of other diseases was cataloged; however, researchers found no viral diseases or diseases exotic to the region. Seven veterinary students or graduate veterinarians received training in salmon health management. A "Best Practices Manual" was prepared describing preventative measures to minimize disease at salmon farm sites.

GRANT NUMBER: NA27FD0038-01 NMFS NUMBER: 91-NER-027
REPORT TITLE: Continued Study of the Production of Mackerel
Surimi
AUTHOR: Hultin, Herbert O.; Kelleher, Stephen D. and
Kim, Jin M.; University of Massachusetts,
Amherst, MA
PUBLISH DATE: April 20, 1994
AVAILABLE FROM: National Marine Fisheries Service
Northeast Region
One Blackburn Drive
Gloucester, MA 01930-2298
PHONE: (978) 281-9267

ABSTRACT

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The overall goal of this project was to determine if improvements reducing lipid oxidation in the production of mackerel surimi which were achieved in the laboratory could be attained in a pilot plant operation. Other goals were to determine ways of improving the color of mackerel surimi, to study the distribution of lipid-soluble antioxidants in the polar and non-polar lipid fractions, to determine the nature of the antioxidants in mackerel light and dark muscle and their potential role in oxidation reactions, and to develop means of separating light and dark muscle tissue. The work demonstrated that the laboratory technique of decreasing lipid oxidation could be achieved on a pilot plant scale.

GRANT NUMBER: NA27FD0044-01 NMFS NUMBER: 91-NER-008
REPORT TITLE: Domoic Acid in the Bay Scallop *Argopecten
irradians* in Nantucket, MA: Sources,
Production, Uptake, and Loss
AUTHOR: Sundell, Tracy
PUBLISH DATE: May 1, 1995
AVAILABLE FROM: National Marine Fisheries Service
Northeast Region
One Blackburn Drive
Gloucester, MA 01930-2298
PHONE: (978) 281-9267

ABSTRACT

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This project was successful in providing some background information regarding the uptake of domoic acid in the Nantucket Bay scallop, *Argopecten irradians* and it demonstrated that domoic acid accumulates in the soft tissues of the bay scallop fed on *Pseudonitzschia pungens* f. multiseriis. Preliminary data suggest that domoic acid does not accumulate when the scallops' metabolic activity and feeding activity are reduced. This project was moderately successful in providing background data on the distribution of the genus *Pseudonitzschia*. Phytoplankton mapping has provided the occurrence of *Pseudonitzschia* around Nantucket during 1992-3. Uptake of domoic acid by bay scallops when feeding on toxic diatoms was demonstrated for the first time.

GRANT NUMBER: NA27FD0065 NMFS NUMBER: 91-SER-026
REPORT TITLE: Evaluation of Available Bioassays for
Brevetoxins in Fish and Shellfish: Correlation
with Cell Concentrations in the Water Column
AUTHOR: Chiral Corporation
PUBLISH DATE: August 30, 1994
AVAILABLE FROM: National Marine Fisheries Service
9721 Executive Center Drive, North
Koger Building
St. Petersburg, FL 33702
PHONE: (813) 570-5324

ABSTRACT

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Available bioassays for detecting brevetoxins in marine seafood were compared, and correlated against analytical HPLC procedures and the AOAC i.p. mouse bioassay. Radioligand synaptosome binding assays, radioimmunoassays, enzyme-linked immunoassays, *Gambusia affinis* fish bioassays, and electrophysiology were utilized as potential substitutes for mouse bioassay. Assays were performed on both natural field-collected specimens before, during, and after a red tide, from laboratory-induced toxic specimens, and from homogenates of seafood sources artificially "spiked" with brevetoxins. *P. brevis* cells or toxin in seawater could be detected using any of the assays utilized. ELISA and RIA were most sensitive in identifying low amounts of brevetoxin. Several new formats were explored, specifically designed for water use, for use as a "presumptive" assay, or for the rigors of routine tissue testing. Synaptosome binding assays and electrophysiology provided the most sensitive methods of identifying very potent toxins. *Gambusia affinis* bioassay proved most useful for rapid screening of toxic fractions, while HPLC methods proved relatively insensitive to toxins with little carbon-carbon unsaturation, and gave no indication of potential toxicity. Biological matrices of shellfish or fish tissue proved problematic for ELISA and HPLC, while RIA and mouse bioassay could detect toxin in these matrices. Two unexpected results were the identification of a new hemibrevetoxin (uncharacterized structurally, Btx-H) from Mote Marine Laboratory cultures, and the discover of irreversible brevetoxin binding to fish tissues. Spectral results are presented for the new hemibrevetoxin, and data is presented for the latter irreversible binding. The ultimate disposition of brevetoxin in fish tissues is not known. That is to say, it is not known if toxin is metabolized to non-detectable forms or if it is sequestered in tissues to non-extractable forms.

GRANT NUMBER: NA27FD0145-01 NMFS NUMBER: 91-SWR-051
REPORT TITLE: Program for Development of Outer Island
Fisheries in Marshall Islands
AUTHOR: Hart, Kevin
PUBLISH DATE: April 1995
AVAILABLE FROM: National Marine Fisheries Service
Southwest Regional Office
501 West Ocean Boulevard, Suite 4200
Long Beach, CA 90802-4018
PHONE: (562) 980-4033

ABSTRACT

In the RMI almost all economic development activities are concentrated in Majuro and to a lesser extent, Arno and Kwajelele Atolls. Until recently few development efforts extended to the outer atolls of the RMI (in part because economic opportunities on these atolls are limited). Copra, the traditional cash crop in the outer atolls, has fluctuated greatly in price and production levels in the 1990s. (During the last 10 years copra prices declined in both relative and absolute terms). Given the lack of opportunity for gainful employment and declining copra prices, emigration to the urban centers is significant, placing considerable burden on public and private sector services. The outlook for discouraging migration to the urban centers appears poor unless individuals can be convinced economic opportunities do exist in the outer atolls. One way to do this is to develop cash-generating opportunities in the outer atolls.

In May 1991, a private entrepreneur (a local boat builder) obtained S-K support for a project with the goal of demonstrating that dried fish products could increase per capita income in the outer atolls of the RMI. The project objectives were to examine methods of capture, preservation, and processing allowing for the export of dried fish products from the outer atolls to municipal centers in the RMI. The project proposed the formulation of production units by family groups or clans in which certain familial members were responsible for capture of fish, while others were responsible for processing and marketing, etc. Technical assistance was provided to demonstrate fish drying, smoking techniques, and marketing strategies. In addition, records were kept on catch and production inputs, along with revenue receipts, to evaluate economic efficiency of these production units. Each family or clan organized as a unit to produce dried, jerked, or salted fish products and allowed the use of small sail-powered fishing boats. The sail-powered fishing boats were leased to each family, with the final disposition based on the effort expended by each group. Fishing gear and processing equipment were made available to the families through inventories established with local business interests. Replacement costs of equipment were borne by each family unit.

GRANT NUMBER: NA27FD0145-01 (Cont'd.)

The project PI traveled to Kiribati to review a similar effort and participated in a regional meeting on novel tuna products sponsored by ACIAR. In addition, the SPC provided for a fish post harvest handling specialist to assist the PI on the project, which included a site visit to the RMI and one of the outer atolls. A total of 43 fishers on three atolls (Ailinlaplap, Namdrik, and Majuro) and over 100 family members were trained in fish drying techniques. An estimated five tons of dried fish product valued at \$20,000 was produced. Thirty solar dryers costing \$4,200; fish processing supplies worth \$1,700; fishing gear costing \$3,000, and four fiberglass sail boats valued at \$11,650 were distributed among 19 family groups participating in the project. The project, which ran for 24 months, was administratively rated as very *successful*, and all project objectives were successfully implemented.

Total project costs were \$100,596, of which \$7,221 were in-kind and \$61,019 were direct federal costs. Project NPV is estimated at \$268,335 with a B/C of 1.38. Most of the benefits identified are attributed to labor. The industry is estimated to have 5 FTE as of 1995 and will have 65 by year the 2022.

GRANT NUMBER: NA27FD0169-01 NMFS NUMBER: 91-SWR-003
REPORT TITLE: Growth and Age Study of Pacific Hagfish
(*Eptatretus stoutis*) off the Central
California Coast
AUTHOR: Nakamura, Royden
PUBLISH DATE: March 7, 1994
AVAILABLE FROM: National Marine Fisheries Service
Southwest Region
501 West Ocean Boulevard, Suite 4200
Long Beach, CA 90802-4213
PHONE: (562) 980-4033

ABSTRACT

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The primary objectives of the project were to determine the growth rates and to describe the general pattern of growth of hagfish using two different approaches in both field and laboratory studies. This project provided a composite picture of hagfish growth patterns and made tentative predictions of size-at-age of the Central California population of Pacific hagfish. The project significantly contributed to the knowledge of growth and population age-size structure, both of which are directly applicable to the development of management and conservation guidelines for the hagfish fishery.

GRANT NUMBER: NA36FD0091 NMFS NUMBER: 92-NER-024
REPORT TITLE: Juvenile Bycatch and Codend Escapee
Survivability in the Northeast
Groundfish Industry
AUTHOR: Carr, H. Arnold; Farrington, Marianne and
Harris, Jessica
PUBLISH DATE: May 1, 1995
AVAILABLE FROM: National Marine Fisheries Service, NOAA
Northeast Region
One Blackburn Drive
Gloucester, MA 01930-2298
PHONE: (978) 281-9267

ABSTRACT

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This study was a continuation of investigations begun in June 1991. During the first year's study, data were collected on bycatch survival. The investigation was expanded during the second year to address both bycatch and cod-end escapee survival. This study sought to expand on these previous efforts to attempt to mitigate handling-induced mortality by providing a less hostile environment on deck while catch is sorted. Results indicated the survival rate of the species investigated is better for the cod-end escapees than it is for those fish landed on deck, even though the project investigated techniques aimed at improving the survivability of those fish landed on deck. The information gathered provides a strong basis to determine actual survival of cod, plaice, and yellowtail that escape from the cod-end or are landed on deck.

GRANT NUMBER: NA36FD0092 NMFS NUMBER: 92-NER-010
REPORT TITLE: Marketing and New Product Development of Great
Lakes Herring
AUTHOR: Donofrio, Michael
PUBLISH DATE: June 1, 1995
AVAILABLE FROM: National Marine Fisheries Service
Northeast Region
One Blackburn Drive
Gloucester, MA 01930-2298
PHONE: (978) 281-9267

ABSTRACT

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The main objective of this project was to develop domestic markets for Great Lakes herring and to development a self-sustaining fishery that provides an economic base for the Native American community. The recipient concluded that the potential for developing high quality Great lakes herring products exists, and consumer acceptance of these products is high. Test marketing of the herring products to consumers and the food industry revealed a strong interest in the distribution of the products.

GRANT NUMBER: NA36FD0095 NMFS NUMBER: 92-NER-029
REPORT TITLE: An Educational Program for Commercial and
Recreational Fishermen to Resolve User Conflicts
AUTHOR: Hasbrouck, Emerson
PUBLISH DATE: December 30, 1994
AVAILABLE FROM: National Marine Fisheries Service
Northeast Region
One Blackburn Drive
Gloucester, MA 01939-2298
PHONE: (978) 281-9256

ABSTRACT

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The goal of this project was to reduce user conflicts and foster cooperation between commercial and recreational fishermen in the New York Marine District. The educational campaign utilized a variety of media resources and delivery approaches. Over 5.5 million commercial fishermen, recreational fishermen, and members of the general public were educated through the print media, videos, public service announcements on cable TV and radio, broadcast news, community affairs talk shows, individual presentations, printed handouts, and hands-on fishing trips. The results of this project will be improved decision making, less hysteria based on misinformation, and a reduction in user conflicts between commercial and recreational fishermen.

GRANT NUMBER: NA36FD0097 NMFS NUMBER: 92-NER-026
REPORT TITLE: Development of the Propionic Acid Fermentation
for the Preservation of Hydrolyzed Gurry
AUTHOR: Levin, Robert E.
PUBLISH DATE: August 30, 1994
AVAILABLE FROM: National Marine Fisheries Service, NOAA
Northeast Region
One Blackburn Drive
Gloucester, MA 01930-2298
PHONE: (978) 281-9267

ABSTRACT

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The objectives of this project were to develop the direct, single step fermentation of hydrolyzed gurry by propionic acid bacteria as a sole process for preservation, eliminating the need for hazardous mineral acids and for addition of organic acids and preservatives; and to study persistence and development of contaminating microorganisms at low concentrations of propionic acid during the fermentation process. Although results are based on the observations of a limited number of bacterial cultures representing various taxa, they suggest a relationship between strong fermentative metabolism and resistance to propionic acid. Even with a 50% inoculum for establishing a rapid propionic acid fermentation of hydrolyzed cod gurry, fermentation was slow, indicating that not only is growth of the organisms slow, but that most of the propionic acid is produced after growth ceases.

GRANT NUMBER: NA36FD0098 NMFS NUMBER: 92-NER-040
REPORT TITLE: Investigation and Development of an Active
Acoustic Deterrent for Harbor Porpoises and the
Gillnet Fishery
AUTHOR: Baldwin, Kenneth C.
PUBLISH DATE: April 1, 1995
AVAILABLE FROM: National Marine Fisheries Service
Northeast Region
One Blackburn Drive
Gloucester, MA 01930-2298
PHONE: (978) 281-9256

ABSTRACT

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The objective of this project was to work toward developing acoustic net alarms to reduce or eliminate the incidental take of harbor porpoise by gillnet fisheries in the Gulf of Maine. Findings indicate that wild, free-swimming porpoise did, on average, respond to the insonification with 50-50.2 kHz sounds by moving away from the sound source. Although this was the only sound tried, it shows a high degree of promise for the development of a pinger device that may keep porpoise away from gillnets.

GRANT NUMBER: NA36FD0099 NMFS NUMBER: 92-NER-050
REPORT TITLE: Domestication of Lake Whitefish-Protein And
Amino Acid Requirement To Optimize Feed
Utilization And Growth
AUTHOR: Dabrowski, Konrad
PUBLISH DATE: November 13, 1996
AVAILABLE FROM: National Marine Fisheries Service
Northeast Region
One Blackburn Drive
Gloucester, MA 01930-2298
PHONE: (978) 281-9256

ABSTRACT

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This project studied the requirements for protein and ten essential amino acids for maximizing growth and optimizing feed utilization in cultured lake whitefish. Through a series of feeding experiments, it determined the quantitative requirement for protein and limiting essential amino acids. Protein requirement was estimated with practical, fish meal-based diets. Weight gain and tissue free amino acids were used as criteria to determine the optimum protein level for growth, which was estimated at 36.5% in the whitefish grow-out phase. Aspartate aminotransferase was characterized in whitefish as an indicator for protein metabolism. Muscle and liver lipids were characterized in whitefish that were fed experimental diets in captivity to marketable size; results indicated enriched levels of polyunsaturated fatty acids (important in human nutrition) in muscle. A broken-line model was used to establish the optimum protein level, and free amino acid concentrations in tissues were used as supporting evidence for physiologically meaningful conclusions. The optimum level of arginine and lysine in the whitefish diet is 1.2-1.5% of dry diet. Changes in free amino acids followed increased levels of these limiting amino acids. Evidence has been presented that a dietary pH around 7.0 improves semi-purified diet utilization; however, further studies must concentrate on increased diet palatability and acceptability. This project resulted in production of the first generation of "domesticated" lake whitefish. Further nutritional studies with domesticated whitefish will accelerate development of diets specifically formulated for this potential new aquaculture species in the Great Lakes region.

GRANT NUMBER: NA36FD0102 NMFS NUMBER: 92-NER-002
REPORT TITLE: Effects of Catch and Release Angling on
Important Northeast Marine Fishes: Mortality
Factors and Applications to Recreational
Fisheries
AUTHOR: Malchoff, Mark
PUBLISH DATE: May 18, 1995
AVAILABLE FROM: National Marine Fisheries Service
Northeast Region
One Blackburn Drive
Gloucester, MA 01930-2298
PHONE: (978) 281-9267

ABSTRACT

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The final report for this project provides the first known estimates of hooking mortality for bluefish. The striped bass work is also important in that it confirms the conclusion that freshwater-based mortality estimates may greatly overestimate post catch and release angling mortality in this species. The results of trials on striped bass, black sea bass, and scup and weakfish given represent the first known mortality estimates based directly on the sampling of sport fishing industry activities. These results confirm some previous estimates based on more conventional methods in different environments, and indicate that post catch and release mortality rates are generally low for these species in these settings. The results are now available for use by the industry and by fishery management agencies faced with the development or revisions to fishery management plans which require such mortality estimates. Educational materials incorporating this information have been updated and are available for distribution in quantity to interested parties.

GRANT NUMBER: NA36FD0131 NMFS NUMBER: 92-NER-019
REPORT TITLE: Evaluation of Scallop Dredge Ring Sizes
AUTHOR: DuPaul, Dr. William and Kirkley, James E.;
Virginia Institute of Marine Science, Gloucester
Point, VA
PUBLISH DATE: October 23, 1995
AVAILABLE FROM: National Marine Fisheries Service
Northeast Regional Office
One Blackburn Drive
Gloucester, MA 01930-2298
PHONE: (978) 281-9267

ABSTRACT

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This project evaluated the performance of 3.5 inch scallop dredge rings during six to eight commercial scallop trips from Mid-Atlantic and New England ports. There were eight trips between September 1993 and April 1995, conducted under various conditions and in different resource areas. From July to August 1994, gear trials were conducted on the Canadian portion of Georges Bank. This was a valuable opportunity as it afforded an evaluation of the 3.5 inch ring in an area with an abundance of scallops with multiple year classes in the population. Three trips were conducted in the Mid-Atlantic region, specifically to evaluate the effects of ring size on a very large incoming year class. Information collected during this project was made available to industry and supporting management agencies via written and oral presentations. A copy of these reports is included in the final report.

GRANT NUMBER: NA36FD0146 NMFS NUMBER: 92-NWR-004
REPORT TITLE: New Medications to Support U.S. Fish Farming
AUTHOR: Elston, Ralph and Drum, Ann S.
PUBLISH DATE: June 15, 1995
AVAILABLE FROM: National Marine Fisheries Service
Northwest Region
7600 Sand Point Way, NE
BIN C15700, Bldg. 1
Seattle WA 98115
PHONE: (206) 526-6117

ABSTRACT

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The goal of the project was to develop new field trial methods needed to generate data for initiation of the drug registration process specific to aquatic cultured fish. Currently, there is a shortage of safe and effective antimicrobial drugs to treat diseases in cultured fish and no validated methods for clinical field trials. Difloxacin, a drug used to treat furunculosis in Atlantic salmon, was used to treat fish in both small scale and production size net pens. The modified net pen showed no significant differences in mortalities between medicated and control fish. However, the mortality rates for rated fish could not be fully assessed because severe outbreaks of furunculosis did not occur during the study period. Operational requirements were developed for use of the small net pen and recommendations were made for further refinements.

GRANT NUMBER: NA36FD0178 NMFS NUMBER: 92-AKR-001
REPORT TITLE: Economic Considerations of Alternative
Management Measures in the Alaska Red King Crab
and Snow Crab Fisheries
AUTHOR: University of Alaska Fairbanks, Department of
Resources Management
PUBLISH DATE: May 17, 1996
AVAILABLE FROM: National Marine Fisheries Service
Alaska Region
709 W. 9th Street, 4th Floor
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Juneau, AK 99801
PHONE: (907) 586-7224

ABSTRACT

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This study examines an overview of the history and current status of Alaska's Bering Sea snow crab and Bristol Bay red king crab fisheries. Management history is covered and special management considerations emanating from biological characteristics of the crab stocks are examined. An econometrics evaluation of pot limits and proposed license limitations is presented and a theoretical overview of ITQs is provided. Socio-economic outcomes of transferable quota management in Iceland, New Zealand, and Australia, the three nations with the oldest and most extensive ITQ systems; as well as the Mid-Atlantic surf clam and quahog fisheries-the first major ITQ experiment in the United States-are reviewed. A theoretical scenario for IFQ management in the BSAI crab fisheries is set up. A likely pattern of initial distributions is sketched, assuming that recipients of licenses under the newly adopted license program would be eligible for quota, and that the amount each receives would be based on his historical catch, using a formula similar to that adopted for the halibut and sablefish program. An economic analysis of Individual Transferable Pot Quotas (ITPQs) was presented to the Council, as part of the Environmental Assessment/Regulatory Impact Review for the License Limitation Alternatives for the Groundfish and Crab Fisheries in the Gulf of Alaska and Bering Sea Aleutian Islands (NPFMC 1994). ITPQs were subsequently rejected by the Council as a possible option for comprehensive rationalization of the BSAI crab fisheries. What comes across in the crab management debate is that before selecting a management plan for any fishery it is important to define the goals of management: whether to ensure maximum profitability to the industry, to secure the fisheries competitiveness, to ensure weak profits to many of strong profits to a few, to maximize employment, to protect the integrity of isolated communities, to ensure consumers a steady supply of high quality fish, to focus on present-day problems or for managers to try to include the financial health of future generations of fishers in their calculations.

GRANT NUMBER: NA36FD0179 NMFS NUMBER: 92-AKR-004
REPORT TITLE: Development of mtDNA Methods for
Identifying U.S. Coho Salmon Stocks (Year 2)
AUTHOR: Gharrett, A.J. and Gray, A.K.
PUBLISH DATE: April 27, 1995
AVAILABLE FROM: National Marine Fisheries Service
Alaska Region
P.O. Box 21668
Juneau, AK 99802
PHONE: (907) 586-7224

ABSTRACT

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The objective of this project was to develop molecular genetic tools for using mtDNA markers in coho salmon stock identification problems. Three steps were required to apply DNA technology to stock separation: a) identification of variable regions for the DNA (markers), b) development of a method to rapidly obtain data for the markers, and c) assembly of baseline information about the distribution of the markers in stocks of interest. The PCR oligonucleotide primers developed and assembled amplified most of the mtDNA of coho salmon in fragments with sizes that are easy to work with, they amplify the mtDNA of other Pacific salmon species as well as some of the mtDNA of more distantly related species. Primers were used to amplify mtDNA fragments from a set of test samples in order to identify restriction sites that were variable and subsequently to increase the scope of the study. From those data, there was substantial genetic variability both within and among most of the collections, and there was a geographical basis to the genetic variability observed.

GRANT NUMBER: NA36FD0181 NMFS NUMBER: 92-AKR-016
REPORT TITLE: Bioeconomic Consequences of Bycatch in Bering
Seas Fisheries
AUTHOR: Criddle, Keith R.
PUBLISH DATE: April 1, 1996
AVAILABLE FROM: National Marine Fisheries Service
Alaska Region
P.O. Box 21668
Juneau, AK 99802
PHONE: (907) 586-7224

ABSTRACT

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A framework was developed for a dynamic multispecies nonlinear optimization model of five aggregate Bering Sea groundfish fisheries. The model couples a state space time series model of multispecies population dynamics with a nonlinear multi-product specification of twelve harvesting and processing operation categories. Data developed from the 1991 inshore-offshore cost survey were used to estimate the parameters of the production functions. The model structure facilitates statistical tests of the significance of observed differences among the operation categories. The estimated econometric model was not significantly better than a simple model based solely on the categorical means in the data.

GRANT NUMBER: NA36FD0358 NMFS NUMBER: 92-NWR-010
REPORT TITLE: The Use of Genetic Stock Identification to
Determine the Migration Timing and Distribution
of Chum Salmon Stocks in Mixed-Stock Fisheries
in South Puget Sound and Hood Canal
AUTHOR: The Northwest Indian Fisheries Commission and
Indian Tribes of Western Washington
PUBLISH DATE: August 24, 1995
AVAILABLE FROM: National Marine Fisheries Service
Northwest Region
7600 Sand Point Way, NE
BIN C15700, Bldg. 1
Seattle, WA 98115
PHONE: (206) 526-6117

ABSTRACT

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The goal of the project was to estimate chum salmon stock composition using genetic stock identification methods for commercial fisheries in the South Puget Sound and Hood Canal harvest areas. Preseason abundance forecasts are based on run sizes in previous years, which have been calculated with accounting for the contribution of non-local stocks to the subject fishery catch areas. The genetic stock identification analyses showed substantial presence of non-local stocks in these fishery catch areas. Incorporating these new stock composition data into run reconstruction models resulted in postseason estimates of 1993 abundance for South Puget Sound and the Hood Canal areas that varied by 17 percent and 8 percent, respectively, from conventional estimates.

GRANT NUMBER: NA36FD0375 NMFS NUMBER: 92-SWR-054
REPORT TITLE: Feasibility of Commercial Black Pearl Farming on
Namdrik Atoll, Marshall Islands
AUTHOR: Black Pearls Inc.
PUBLISH DATE: August 15, 1995
AVAILABLE FROM: National Marine Fisheries Service
Southwest Regional Office
501 West Ocean Boulevard, Suite 4200
Long Beach, CA 90802-4018
PHONE: (562) 980-4033

ABSTRACT

The goal of this project sought to lay the foundation for commercial black-lip pearl oyster (*Pinctada margaritifera*) farming in the Republic of the Marshall Islands. The objectives were the provision of spat for commercial farming, proving the feasibility of farming methods, the marketability of Marshall Islands black pearls and provide training and extension services.

A stock assessment was completed in one lagoon, while spat collector trials indicated that spat settlement was insufficient for commercial production. Remote hatchery production trials proved technically feasible. Grow out trials showed excellent growth, but significant predation occurred by parasitic snails. Marketing efforts of half-pearls appeared positive and extension and training activities were deemed a success. The projects results suggest that black-lipped pearl farming is economically viable if lagoon tenure, spat production and growout survivability problems can be ameliorated.

GRANT NUMBER: NA36FD0384 NMFS NUMBER: 92-NER-009
REPORT TITLE: Molecular Tagging of Lake Sturgeon as a Means of
Identification for Use in Developing a
Domesticated Breeding Stock, for Use in
Population Re-Establishment, and for Use in
Conservation Enforcement Programs
AUTHOR: Eckhardt, Ronald A. and Jahangir, Z.M.G. Sarwar
PUBLISH DATE: June 11, 1996
AVAILABLE FROM: National Marine Fisheries Service
Northeast Region
One Blackburn Drive
Gloucester, MA 01930-2298
PHONE: (978) 281-9267

ABSTRACT

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The objective of this project was to produce a molecularly tagged breeding stock of lake sturgeon to ensure the positive identification of their progeny in nature and in the commercial marketplace. In order to generate an initial stock of transgenic lake sturgeon carrying a non-removable molecular tag, lake sturgeon eggs were micro-injected with an *Escherischia coli* B-galactosidase gene coupled to constitutive SV40 promoter immediately after fertilization. The resulting embryos and fish have been tested for bacterial B-galactosidase expression by determining their ability to form an indigo blue color after exposure to X-gal solutions. More than 35% of the micro-injected embryos displayed B-galactosidase activity. Control embryos showed no color development under identical conditions, which eliminates the possibility that the blue color formed by the experimental embryos was caused by endogenous B-galactosidase. At the end of the project, the transgenic stock was chemically preserved for future study of the distribution of bacterial B-galactosidase gene expression in various tissues and organs. Although not field tested, it is believed that the transgenic lake sturgeon stock generated by this project would have been useful for: (1) positive identification of illegally taken lake sturgeon; (2) population estimation following standard release/recapture methods; (3) population re-establishment/enforcement conservation programs. Moreover, since the efficacy of the methods used to generate transgenic lake sturgeon has been clearly demonstrated, it is believed that the same techniques may be used in the future to produce transgenic stocks of other commercially important fish species in order to address similar practical problems in various fisheries.

GRANT NUMBER: NA37FD0032-01 NMFS NUMBER: 92-SER-023B
REPORT TITLE: Organization and Management of Gulf of Mexico
and South Atlantic Ocean Fishery Bycatch Program
(Year 2)
AUTHOR: Gulf and South Atlantic Fisheries Development
Foundation
PUBLISH DATE: September 16, 1994
AVAILABLE FROM: Gulf and South Atlantic Fisheries Development
Foundation
5401 West Kennedy Blvd.
Tampa, FL 33609
PHONE: (813) 286-8390

ABSTRACT

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This project provided for the initiation of research designed to gather information on characterization of bycatch and effectiveness of bycatch reduction devices (BRD). Various types of BRD gear were tested and workshops were held to familiarize shrimp fisherman with the BRD. The eventual goal is the successful reduction of finfish bycatch in the shrimp fishery. Such a result is ecologically and economically beneficial to the industry, the region, and the Nation. Successful completion of a bycatch reduction program will economically benefit the shrimp industry and other fisheries affected by the incidental mortality which occurs in the shrimp fishery, and will have a positive ecological impact on the marine faunal community that inhabits the shrimp grounds.

GRANT NUMBER: NA37FD0077 NMFS NUMBER: 92-SER-007
REPORT TITLE: Synthetic and Derivative Approaches
Towards Marine Biotoxins Standards
AUTHOR: Chiral Corporation
PUBLISH DATE: April 1, 1996
AVAILABLE FROM: National Marine Fisheries Service
Southeast Region
9721 Executive Center Drive, North
Koger Building
St. Petersburg, FL 33702
PHONE: (813) 570-5324

ABSTRACT

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The goal of this project was the mass cultivation of marine dinoflagellates responsible for neurotoxic shellfish poisoning, paralytic shellfish poisoning, and diarrhetic shellfish poisoning. Laboratory cultures of *Ptychodiscus brevis*, *Gymnodinium catenatu*, and *Prorocentrum lima* were quantified and purified to homogeneity. Saxitoxin and its derivatives and the brevetoxins and derivatives were the focus of this work. Twenty-five derivatives and potential metabolites of the brevetoxins were produced and the lethality of each was evaluated. Purification was achieved using HPLC under reverse phase elution conditions. Saxitoxin and its derivatives were produced from *G. catenatum* cultures and were quantified by HPLC using the Sullivan post-column fluorescent derivatization method, and by capillary electrophoresis. Synthetic saxitoxin protocols were thoroughly investigated and were found to be unprofitable and unattainable for producing saxitoxin in large amounts for the industry as standards.

GRANT NUMBER: NA37FD0080 NMFS NUMBER: 92-SER-017
REPORT TITLE: Bycatch of Atlantic and Shortnose Sturgeon in
the South Carolina Shad Fishery
AUTHOR: Collins, M.R. and Smith, Theodore I. J.
PUBLISH DATE: December 1, 1994
AVAILABLE FROM: National Marine Fisheries Service, NOAA
Southeast Region
9721 Executive Center Drive, North
Koger Building
St. Petersburg, FL 33702
PHONE: (813) 570-5324

ABSTRACT

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The sturgeon bycatch of the commercial American shad set gill net fishery in Winyah Bay, South Carolinas was documented during the 1994 season. Examination of the bycatch from 2,561 net-hr of effort resulted in examination of 23 Atlantic (57-132 cm TL, nominal ages 2-7 years from pectoral spine sections) and 4 shortnose (57-90 cm TL) sturgeons, for a CPUE of 0.011 sturgeon/net-hr. Three Atlantic sturgeon were dead and four were lightly to severely injured. Total fishing effort in the study area during the 1994 season was estimated (using overflights) as 10,536 net-hr, permitting an expansion of the bycatch to an estimated 115 sturgeon (85% Atlantic), of which it was estimated that 12 died in the nets and 17 were released with varying injuries. All fish released alive were tagged, and two Atlantic sturgeon were recaptured. It was experimentally documented for Atlantic sturgeon that clipped barbels (for genetic samples) regenerate and wounds from pectoral spine removal (for ageing) heal readily. Substantial progress was made in establishing a computer data base of all available information on the distribution and occurrence of sturgeons in South Carolina waters; more than 3,000 individuals are now on record.

GRANT NUMBER: NA37FD0081 NMFS NUMBER: 92-SER-023
REPORT TITLE: Limited Entry in the Florida Stone Crab
Fishery: A Multi-Species Approach
AUTHOR: Johnson, Jeffrey C. and Orbach, Michael K.
PUBLISH DATE: December 1, 1995
AVAILABLE FROM: National Marine Fisheries Service
Southeast Region
9721 Executive Center Drive, North
Koger Building
St. Petersburg, FL 33702
PHONE: (813) 570-5324

ABSTRACT

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The purposes of the project which started under grant NA17FD0106-01 were: 1) to collect socio-economic and socio-cultural data on the Florida stone crab fishery for the purpose of designing and evaluating limited entry alternatives for that fishery; and 2) to develop alternatives for limited entry in the Florida stone crab fishery, and through a series of constituent workshops to assess the potential impacts of those alternatives against a specified set of criteria. A total of 239 in-depth interviews were conducted with a random stratified sample of stone crab licensees throughout Florida. A wide range of data on demographics of the fishers and their families and communities, fishing practices and history, network interactions and perceptions of management issues and alternatives were collected. In addition, ethnographic research was carried out in several principal stone crab fishery locations. Thirty-three constituent workshops in three different series were conducted around the state of Florida to develop and discuss alternatives for limited entry in the Florida stone crab and related fisheries. The data from the research portion of the project and the comments from fishery constituents during the workshops displayed several attributes of the stone crab fishery: 1) Stone crab fishing is significantly related to spiny lobster fishing in the southern portion of the state and to blue crab fishing on the upper west, and to a lesser extent east, coasts; 2) While effort in terms of numbers of traps in the stone crab fishery appears to have been increasing, the fishery does not exhibit the strong downward trend in catch per trap and other related fishery effects seen in the spiny lobster fishery of the 1970s and 80s; 3) Effort in the stone crab and related fisheries such as blue crab has been significantly affected by events external to the fisheries themselves, such as the new trap certificate and reduction system in the Florida spiny lobster fishery and the successful 1994 Florida "net ban" referendum. The major recommendations from the project were to place a four-year moratorium on Florida stone crab licenses, during which time a permanent limited entry system should be developed; and to add stone crab to the Florida "restricted species" list, a designation which means that an individual would have to make \$5,000 or 25% of his or her income from the sale of fish to GRANT

NUMBER: NA37FD0081 (Cont'd.)

qualify for a stone crab license. Both of these recommendations, the moratorium and the restricted species designation, were passed into law during the 1995 session of the Florida Legislature with the support of our collaborating industry group on this project, the Organized Fishermen of Florida.

GRANT NUMBER: NA37FD0082 NMFS NUMBER: 92-SER-025
REPORT TITLE: Development of a Polymerase Chain Reaction (PCR)
-Gene Probe-Based Detection of Microbial
Pathogens from Seafood
AUTHOR: Asim, K. Bej and Jones, Daniel D.
PUBLISH DATE: August 30, 1996
AVAILABLE FROM: National Marine Fisheries Service
Southeast Region
9721 Executive Center Drive, North
Koger Building
St. Petersburg, FL 33702
PHONE: (813) 570-5324

ABSTRACT

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The project was able to show that use of the conventional PCR approach using DNA as a target showed positive amplification detection of non-viable cells of *Vibrio cholerae* which, in many instances, would be considered a false-positive result. Total RNA from both viable and non-viable cells were purified and treated with DNase (RNase-free) to avoid any amplification from the contaminating target DNA. A RT-PCR approach using this rapid and effective method for RNA purification showed amplification of the target RNA only from the viable cells. The sensitivity of detection of viable cells of *V. cholerae* was greater than or equal to 10^3 , which is well within the minimum number of cells required for infection. The use of a reliable prokaryotic RNA extraction method followed by RT-PCR amplification of the target RNA can be used for specific detection of viable microbial pathogens such as *V. cholerae*, avoiding undesired false-positive results.

GRANT NUMBER: NA37FD0087 NMFS NUMBER: 92-SER-035
REPORT TITLE: King Mackerel Hooking Mortality
AUTHOR: Randy E. Edwards, Ph.D., Mote Marine Laboratory
PUBLISH DATE: July 20, 1996
AVAILABLE FROM: National Marine Fisheries Service
Southeast Regional Office
9721 Executive Center Drive, North
Koger Building
St. Petersburg, FL 33702
PHONE: (813) 570-5324

ABSTRACT

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The original goals of the project were to improve preliminary estimates of king mackerel release mortality, and to determine if hooking mortality estimates based on short-term (first two hours after release) survival can be used to provide reasonable estimates to hooking mortality, by tracking king mackerel for periods of up to 24 hours. An ancillary goal was to provide information which would increase confidence in hooking mortality estimates for Spanish mackerel and would serve as rough estimates for hooking mortality of other pelagic fishes. A total of 18 king mackerel were caught, tagged and released. Of these, 16 were tracked and two were lost. With regard to the first goal, the additional number of king mackerel tracked during this project greatly improved the estimate of king mackerel release mortality by decreasing the statistical confidence interval. Previously, the estimated mortality would have been 17.6% with a 95% confidence interval of 3.3 to 48.5% (Edwards, 1994). As a result of the project, the estimate was revised to 19.4% and the 95% confidence interval was reduced to 7.4 to 37.8%. If past data on Spanish mackerel release mortality are pooled with the present information on king mackerel, a release mortality estimate of 8.9 to 28.5% is obtained. With regard to the second goal, the project showed that the projected low (<10%) release mortality was a reasonable estimate. Taken together, these two findings should allow fishery managers to apply reasonable estimates of hooking mortality for king mackerel (and indirectly to Spanish mackerel and other pelagic species) with reasonable confidence.

GRANT NUMBER: NA37FD0094 NMFS NUMBER: 92-NER-005
REPORT TITLE: Relative Location of Juvenile Groundfish and
Northern Shrimp Populations by Season Between
Shore and the 50 Fathom Curve in the Western
Gulf of Maine
AUTHOR: Schick, Daniel F. and Brown, Michael
PUBLISH DATE: May 23, 1995
AVAILABLE FROM: National Marine Fisheries Service
Northeast Region
One Blackburn Drive
Gloucester, MA 1930-2298
PHONE: (978) 281-9267

ABSTRACT

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The overall goal of this project was to identify locations and times at which shrimping could occur without impacting juvenile groundfish. This project concluded there are definite times and locations when marketable shrimp are physically separated from most, but not all, groundfish stocks. These times and locations may not be consistent between years. Minimizing shrimp fishing impact on groundfish resources by limiting shrimp fishing to time and locations that are essentially free from groundfish would require up-to-the-minute distribution information and constant, reliable feedback from the fishing fleet as to when bycatch starts to increase. It was concluded that this method should only be considered if other methods fail.

GRANT NUMBER: NA37FD0104 NMFS NUMBER: 92-NER-025
REPORT TITLE: Economic Valuation of Marine Recreational
Fishing for Large Pelagic Species
AUTHOR: Kaoru, Yoshi and Hoagland, Porter
PUBLISH DATE: November 9, 1995
AVAILABLE FROM: National Marine Fisheries Service
Northeast Region
One Blackburn Drive
Gloucester, MA 01930-2298
PHONE: (978) 281-9267

ABSTRACT

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This project was undertaken to fill the information gap between the commercial fishing benefits and recreational fishing benefits for deciding management actions over large pelagic species. Given the lack of existing information about economic benefits of recreational fishing for large pelagic species, this project provided an important source of information toward better utilization of the marine fishery resources. On average, an angler took 11.4 trips, kept 20.7 fish and released 20.3 fish in 1993. The average travel expenditure was \$596 per trip, and an angler spent \$6,597 for boat and fishing equipment, maintenance, permit, insurance, and registration in 1993. On average, 13.4 percent of anglers sold their catch, receiving \$515. Economic benefits accruing to anglers were found to be very large. Furthermore, their preference and willingness to pay to catch one fish vary substantially over different target species. Management decisions should be made with the understanding of their impacts on the recreational fishing sector.

GRANT NUMBER: NA37FD0144 NMFS NUMBER: 92-NWR-008
REPORT TITLE: Physical, Chemical, and Genetic Differences
Associated with Harmful Marine Phytoplankton:
Heterosigma and Domoic Acid Producers
AUTHOR: Banse, K.; Cattolico, R.A.; and Taub, F.B.
PUBLISH DATE: May 17, 1994
AVAILABLE FROM: National Marine Fisheries Service
Northwest Region
7600 Sand Point Way, NE
BIN C15700, Bldg. 1
Seattle, WA 98115
PHONE: (206) 526-6117

ABSTRACT

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The objectives of this project were: to define the nutrient and physical conditions that cause *Heterosigma* to be toxic to certain fish; develop a chemi-luminescent probe for the rapid identification; and, survey the regional and seasonal distribution of *Pseudonitzschia*, a planktonic diatom that produces domoic acid. Researchers found that decreased surface salinity causes *Heterosigma* to become toxic, or the mode of toxicity, were not evident. Development of a fluorescent detection method for *Heterosigma* was initiated. A methodology was developed to induce toxicity for *Heterosigma*. Water samples were collected and examined for the presence of *Pseudonitzschia* and other harmful species. Lists of all phytoplankton species found were enumerated in an attempt to understand more about their spatial and temporal distribution and abundance in western Washington marine waters. Thirteen cultures of *Pseudonitzschia* were isolated from samples taken during the project.

GRANT NUMBER: NA37FD0183 NMFS NUMBER: 92-AKR-018
REPORT TITLE: A Proposed GIS-Based Fisheries Information
Management System
AUTHOR: LGL Alaska Research Associates, Inc.
PUBLISH DATE: March 24, 1995
AVAILABLE FROM: National Marine Fisheries Service
Alaska Region
P.O. Box 21668
Juneau, AK 99802
PHONE: (907) 586-7224

ABSTRACT

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Use of geographic information system technology (GIS) and relational database technology could provide significant benefits to fishery scientists, resource managers, and the fishing industry. Large, well-established fisheries databases can be linked and accessed using a user-friendly interface on personal computers and workstations making fisheries and other data more accessible to a variety of users. This project began with a conceptual model which later led to a working computer prototype. The utility of the proposed system, using actual fisheries data, was demonstrated by applying the fisheries information management system to six management scenarios.

GRANT NUMBER: NA37FD0191 NMFS NUMBER: 93-WO-044
REPORT TITLE: Replicative Potential, Tissue Distribution and
Survival in Molluscan Shellfish of Putative
Norwalk-like Caliciviruses Originating from
Ocean Hosts
AUTHOR: Smith, Professor Alvin W.
PUBLISH DATE: March 21, 1997
AVAILABLE FROM: National Marine Fisheries Service
219 Fort Johnson Road
Charleston, SC 29412
PHONE: (803) 762-1200

ABSTRACT

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The objective was to develop extraction and assay methods for recovering known caliciviruses from various tissues of shellfish given a measured quantity of virus, and to test for calicivirus replication in shellfish exposed to various known caliciviruses. Molluscan shellfish are known to be contaminated with several potential human pathogens including the caliciviruses, which have been implicated in severe outbreaks of viral gastroenteritis. Lack of specific, reliable tests for caliciviruses and other pathogens has resulted in shellfish waters being closed to harvesting because the status of contamination could not be determined. Furthermore, decontamination methods of relaying and depuration have proven to be inadequate for insuring the safety of raw shellfish contaminated with caliciviruses. Under this project, caliciviruses were isolated from naturally and experimentally exposed shellfish stocks using mammalian cell culture systems. Retention (and possible replication) of these viruses in shellfish was demonstrated for 60 days or more under depuration using continuous flow sterile sea water. The project also demonstrated that caliciviruses occur naturally within ocean sources including shellfish, and identified calicivirus contamination in both open and closed shellfish beds on all coasts (Atlantic, Gulf, and Pacific), although the source of these viruses (marine and terrestrial) remains unknown.

GRANT NUMBER: NA37FD0193 NMFS NUMBER: 92-WO-031
REPORT TITLE: A Rapid, Inexpensive Screening Test For Seafood
Contamination
AUTHOR: Anderson, Dr. Jack W. and Jones, Jennifer M.
PUBLISH DATE: March 15, 1997
AVAILABLE FROM: National Marine Fisheries Service
219 Fort Johnson Road
Charleston, SC 29412
PHONE: (803) 762-8526

ABSTRACT

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To develop and refine the Reporter Gene System (RGS) for use in rapid screening of seafood products for the presence of toxic, carcinogenic or mutagenic contaminants; to transfer to government laboratories; and to provide guidance for the potential transfer to government laboratories. Use of this approach on field-collected or shipped samples will test the ability of the method to screen actual samples and compare the responses of the RGS to chemical analyses.

GRANT NUMBER: NA37FD0216 NMFS NUMBER: 92-WO-038
REPORT TITLE: Determination of the Viable Form of *Vibrio*
vulnificus in Cold Water Environments
AUTHOR: Tamplin, Mark L.
PUBLISH DATE: November 1, 1994
AVAILABLE FROM: National Marine Fisheries Service
Southeast Region
P.O. Box 12607
Charleston, SC 29412
PHONE: (803) 762-8526

ABSTRACT

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The steady economic decline in molluscan shellfish industries can be attributed, in part, to the impact of *Vibrio vulnificus* on public awareness of seafood safety. Although the number of *V. vulnificus* cases is low compared to the estimated 9,000,000 annual foodborne illness, and associated > 9,000 deaths, the inability to predict risk based on fecal coliform standards has compelled public health agencies to consider new control practices. It is well established that environmental levels of *V. vulnificus* parallel the incidence of clinical illness, supporting the hypothesis that *V. vulnificus* disease is related to increased bacterial concentration. In cold winter months, *V. vulnificus* cannot be readily detected in shellfish, and no human disease occurs. This has raised the question, "Where does *V. vulnificus* reside during cold months, and from what reservoir(s) does it reappear?" Some scientists propose that low temperature causes *V. vulnificus* to exist in a viable, but nonculturable (VBNC) form that becomes culturable when water temperature increases.

GRANT NUMBER: NA37FD0227 NMFS NUMBER: 92-WO-021
REPORT TITLE: A New Toxic Dinoflagellate Affecting Cultured
and Wild Estuarine Fish
AUTHOR: North Carolina State University
PUBLISH DATE: February 6, 1997
AVAILABLE FROM: National Marine Fisheries Service
National Program Office
1315 East-West Highway
Silver Spring, MD 20910
PHONE: (301) 713-2358

ABSTRACT

The goal of the project was to characterize the ecological distribution, algal physiology, disease effects, and toxin of a new toxic dinoflagellate, *Pfisteria piscicida*, recently discovered in the Albemarle-Pamlico Estuary. The organism is highly toxic and has been implicated in several major fish kills. The project was temporarily halted until a more rigid safety plan for handling the toxic dinoflagellate in the laboratory was developed. A field sampling survey for *Pfisteria piscicida* was conducted in the Albemarle-Pamlico Estuary. Collaborators also identified this organism in the Delaware Bay and Chesapeake Bay Estuaries. The optimal salinity for toxic blooms was determined to be 15 ppt, with a range from nearly freshwater to 35 ppt. Fish were exposed to a standardized concentration of the algae and examined. A variety of adverse effects were observed in toxin-exposed fish, including massive skin damage, edema, and hematological changes. The toxin was successfully extracted from seawater and the extract was demonstrated to kill fish in a bioassay.

GRANT NUMBER: NA37FD0521-01 NMFS NUMBER: 92-SWR-057
REPORT TITLE: Small Scale Sustainable Sport Fishery
Development for Palau: Assessment, Strategy and
Consensus-Building
AUTHOR: Idechong, Noah; Palau Conservation Society, via
contract for the Division of Marine Resources,
Bureau of Natural Resources and Development,
Ministry of Resources and Development, Republic
of Palau
PUBLISH DATE: October 1996
AVAILABLE FROM: National Marine Fisheries Service
Southwest Regional Office
501 West Ocean Boulevard, Suite 4200
Long Beach, CA 90802-4018
PHONE: (562) 980-4033

ABSTRACT

The overarching goals of this project were to develop a sustainable sport fishery in Palau that 1) targeted small scale fishermen, 2) was compatible with sustainable ecotourism and 3) help provide for the conservation and "best use" of Palau's inshore fishery resources. Primary objectives included 1) the assessment of the conditions in Palau pertinent to the inshore sport fishery development, and 2) the design of a strategy to introduce a sportfishing system. A facilitating objective concerned consensus building between fishermen, leaders in the fishing and tourism sectors, and government officials. These project goals and objectives were attained. Sport fishery development was determined to be feasible and positively viewed by Palauans. A sport fishery strategy was developed to be used in the implementation of an economic diversification program. The project also led to the introduction of national legislation related to sport fishery development in Palau.

GRANT NUMBER: NA46FD0045 NMFS NUMBER: 92-SWR-058
NA57FD0082 93-SWR-050
REPORT TITLE: Propagation of Reef Corals in International
Aquarium Trade
AUTHOR: Heslinga, Gerald A.; Micronesian Mariculture
Demonstration Center, Koror, Palau
PUBLISH DATE: January 15, 1995
AVAILABLE FROM: National Marine Fisheries Service
Southwest Regional Office
501 West Ocean Boulevard, Suite 4200
Long Beach, CA 90802-4018
PHONE: (562) 980-4033

ABSTRACT

There are a number of uses for mariculture products. Traditionally they were a source of food, and to a lesser extent, for jewelry (pearls and trochus). However, niche industries are developing, and the international aquarium trade has proven to be a valuable outlet for maricultured giant clams and tropical fish. This multimillion dollar industry is currently constrained by two factors-the increasingly restrictive regulatory climate surrounding the collection of tropical specimens and the negative public perception by individuals who are involved in unsustainable harvest of desired species. This is especially true for those species that are central to the marine ecosystem such as giant clams, corals, and marine invertebrates. Today the harvest of hard corals is totally or partially banned in many nations and many species of corals are regulated by the Convention on the International Trade in Endangered Species (e.g., the family of Scleractinia and certain-Hydrozoan, Anthecatans and Stolonifera). One response of the aquarium industry has been to deemphasize the sale of wild caught coral specimens and promote the production and sale of artificial corals which are typically fabricated of molded plastic. While a reasonable approach, this has left a significant number of hobbyists seeking environmentally friendly alternatives.

In 1992 the MMDC received support for a project with the goal of developing methods for the controlled, sustainable mass propagation of commercially valuable corals for the international salt water aquarium trade. The project was to focus on three families (Alcyonacea, Scleractinea, and Zoanthidea) of coral during a three award project, with the following objectives for each family: locate and identify commercially valuable species of each family, conduct experiments aimed at developing cost-effective protocols for reproducing two or three species of each family, test market in cooperation with local and international wholesalers and report results at trade shows and in technical articles.

GRANT NUMBER: NA46FD0045 (Cont'd.)

The first award focused on three of species soft coral (Alcyonacea) and ran for 12 months in 1993 and 1994. Two species were successfully propagated and marketed (*Sarcophyton trocheliophorum* and *Nepthea* sp). An agreement was reached with a private aquarium wholesaler and demand for the corals proved very strong, selling for \$4-\$7 per specimen. A second award focusing on the Scleractinids was awarded but was not implemented due to personnel change at the MMDC. Despite the truncation of the project it is rated as an administrative *success*. Operationally the project was *successful*, and cancellation of the second award appears not to have constrained the development of this niche market. A number of other entities, both in the private and public (UOG, the Honolulu Aquarium) sector have continued experimenting and several are marketing stony corals.

The project cost a total of \$84,799 (the second and third phases were terminated by mutual consent). The markets grew considerably despite cancellation of the second phase of the cultured coral propagation project and at least three private firms were active as of 1995. The NPV of the project is conservatively estimated at \$321,842 with a B/C of 1.67. This estimate does not include other coral propagation activities in the hard and carpet corals which were stimulated as a result of the project. The cancellation of the second and third phases of the project can also be viewed as "savings" but has not been added to the benefit portion of the NPV calculation. This is an example of a Case II B/C in which the activity did not exist prior to the project.

GRANT NUMBER: NA46FD0075 NMFS NUMBER: 91-WO-032
REPORT TITLE: To Develop Seafood Random Weight UPC Numbering
System for Shellfish and Retail Seafood Identity
System Manuals
AUTHOR: National Fisheries Institute, Inc.
PUBLISH DATE: September 12, 1995
AVAILABLE FROM: National Fisheries Institute, Inc.
1525 Wilson Blvd., Suite 500
Arlington, VA 22209
PHONE: (703) 524-8880

ABSTRACT

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This project updated the Universal Product Code (UPC) Numbering System to include shellfish and to assign codes for shellfish species and market forms. Using the FDA's Seafood List as a starting point, and with input from industry, government, and the UPC Council, the grantees revised two manuals, Retail Seafood Identity System, a reference for fish species and their various product forms, and Seafood Random Weight UPC Numbering System. The revisions were necessary to incorporate shellfish names and codes, and to address changes in Federal laws and regulations since the initial publication of the manuals. The updated manuals provide guidance to the seafood industry on labeling shellfish products and provide retailers with UPC designations for random weight shellfish products.

GRANT NUMBER: NA46FD0323 NMFS NUMBER: 93-NER-019
REPORT TITLE: Cutting "In Solution" As A Method of Improving
Atlantic Mackerel Fillet Quality
AUTHOR: Richards, Mark P.; Kelleher, Stephen D.; and
Hultin, Herbert O.; University of Massachusetts,
Amherst, MA
PUBLISH DATE: March 19, 1996
AVAILABLE FROM: National Marine Fisheries Service
Northeast Regional Office
One Blackburn Drive
Gloucester, MA 01930
PHONE: (978) 281-9256

ABSTRACT

The purpose of this study was to determine if it was possible to improve the quality of mackerel fillets by filleting them under water. Treating cut mackerel fillets with a liquid to remove pro-oxidative compounds was advantageous o the product. Supplementation with antioxidants improved the process further. The highest quality product was produced when fresh fish were used. Unfortunately, this process will produce a waster water that has a high BOD due to the blood proteins that accumulate. Electrocoagulation appears promising to recover the protein and clean up the wash water to make this process feasible on an industrial scale.

GRANT NUMBER: NA46FD0326 NMFS NUMBER: 93-NER-002
REPORT TITLE: Deep Water Fishing Potential
AUTHOR: Kvilhaug, Malvin and Smolowitz, Ronald
PUBLISH DATE: January 31, 1996
AVAILABLE FROM: National Marine Fisheries Service
Northeast Region
One Blackburn Drive
Gloucester, MA 01930-2298
PHONE: (978) 281-9267

ABSTRACT

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The commercial fishing vessel *Contender* (106' LOA), operating out of Fairhaven, Massachusetts, conducted twelve exploratory fishing and gear development trips (90 DA) to the upper continental shelf waters of southern New England and the Middle Atlantic Bight. The gear consisted of commercial bottom trawls and towing depths ranged from 200 to 1800 m. The fishing periods were from November 12, 1994 to January 27, 1995 and from September 14, 1995 until November 7, 1995. Commercial landings from these trips included four species of hake, monkfish, grey sole, squid, royal red shrimp, butterfish, summer flounder, and lobsters. Other commercial and potentially commercial species present in the catch included turbot, redfish, red crab, black dogfish, grenadier, and blue hake. The report discusses the significant operational and managerial problems that need to be overcome to successfully fish the upper slope in a sustainable manner. Forty references on deep water fishing are annotated and included in the report.

GRANT NUMBER: NA46FD00327 NMFS NUMBER: 93-NER-009
REPORT TITLE: Polyculture of Sea Scallops Suspended From
Salmon Net Pens
AUTHOR: New England Fisheries Development Assoc., Inc.
PUBLISH DATE: September 1996
AVAILABLE FROM: National Marine Fisheries Service
Northeast Region
One Blackburn Drive
Gloucester, MA 01930-2298
PHONE: (978) 281-9267

ABSTRACT

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This project demonstrated that sea scallops (*Placopecten magellanicus*, initial size 10 mm) held in pearl nets adjacent to salmon net pens can grow to market size (60-70 mm) in 22 months. Growth rates of 0.09 and 0.10 mm/day were attained at the two sites in Northeastern Maine, and were as high as 0.12 mm/day during the first 16 months. Neither accelerated nor decelerated growth due to the scallops being held in close proximity to the salmon pens was evident. Mean shell heights were significantly different with the depth of the pearl nets, however, no consistent pattern of shell height with depth was apparent. Overall survival of scallops held in pearl nets was 64.3% and 66.2% at the two sites. Periodic testing for PSP toxins indicated that scallops grown in the area studied would be unlikely candidates for sale in whole animal or roe-on markets. Farm-raised scallops were not significantly different from commercial scallops in taste and texture, and would be an acceptable product to consumers. Improvements in methodology need to be made before scallops can be raised in polyculture with salmon in a cost effective manner. Methods to improve the economics are discussed, such as decreasing labor costs and increasing growth rates of scallops. This study demonstrated good growth of scallops, a new use for a previously unutilized space, and a possible way for fish farmers to diversify.

GRANT NUMBER: NA46FD0328 NMFS NUMBER: 93-NER-012
REPORT TITLE: Biotic and Abiotic Factors
AUTHOR: Beal, Dr. Brian F. and Fegley, Dr. Stephen R.
PUBLISH DATE: September 30, 1996
AVAILABLE FROM: National Marine Fisheries Service
Northeast Region
One Blackburn Drive
Gloucester, MA 01930-2298
PHONE: (978) 281-9267

ABSTRACT

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Soft-shell clams, *Mya arenaria* L., have been harvested commercially from the intertidal along the Maine coast since the mid-1800's. Historically, 45% to 65% of all clams landed in Maine are harvested in the two eastern countries (Hancock and Washington) where, because of geographic proximity to the Bay of Fundy, twice-daily 4-9 m tides expose vast expanses of clamming habitat compared to coastal regions in more southerly regions of the state. Between 1982 and 1992, landings in the eastern region declined by 90% while, concomitantly, landings in south western Maine increased by 15% over the same time interval. To better understand the factors that may have contributed to the apparent resource decline in eastern Maine, we conducted parallel manipulative experiments at six intertidal mudflats in eastern and southwestern Maine from April to November 1995 to determine biotic aspects of the dynamics of newly settled soft-shell clam populations. At each of the twelve sites, we initiated a long-term experiment (Experiment I) to examine the interactive effects of tidal height (high vs. low) and predator exclusion netting on clam recruitment using a generalized randomized block design. In April, at each location, 240 four-inch plastic plant pots were filled with "mason" sand and buried flush with the sediment. These 2,880 experimental units remained undisturbed for seven months when the contents of each were sieved using an 1,180 u screen.

GRANT NUMBER: NA46FD0330 NMFS NUMBER: 93-NER-007
REPORT TITLE: Commercial Tank Culture of Summer Flounder
AUTHOR: New England Fisheries Development Association
PUBLISH DATE: May 1996
AVAILABLE FROM: National Marine Fisheries Service
Northeast Region
One Blackburn Drive
Gloucester, MA 01930
PHONE: (978) 281-9267

ABSTRACT

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Prior Saltonstall-Kennedy Research has shown summer flounder, *Paralichthys dentatus*, to be a potential candidate for commercial culture. This project undertook numerous experiments to determine the feasibility of commercial culture. Experiments were directed at both the larval and juvenile stages of the fishes life history. The research was aimed at improving larval survival, better defining nutritional needs and at what stages these needs are critical, stocking densities of juveniles, growth rates, feed trials and how to minimize the development of malpigmented juveniles. Additional research evaluated the market potential for farm raised summer flounder and the economics of farming summer flounder in a land-based tank farm. Since one of the most likely scenarios of a commercial tank farm would include recirculating technology, the research involved setting up a recirculating system for all of the juvenile culture experiments.

GRANT NUMBER: NA46FD0331 NMFS NUMBER: 93-NER-006
REPORT TITLE: Alternative Technologies to Improve the
Economics of Treating Clam Processing Waste
Water
AUTHOR: Kuenster, Susan; New England Fisheries
Development Foundation
PUBLISH DATE: September 1996
AVAILABLE FROM: National Marine Fisheries Service
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One Blackburn Drive
Gloucester, MA 01930
PHONE: (978) 281-9256

ABSTRACT

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The segment of the seafood industry most severely impacted by implementation of the Clean Water Act of 1972 has been clam processing. In many cases, municipal treatment facilities have required clam processing plants to decrease the organic load of their effluent and/or have substantially increased the cost of treatment. This project investigated novel methodologies for treating waste water, in an attempt to help clam processors decrease their dependence on municipal treatment facilities. While potentially profiting from the sale of the end-products of treatment. Three alternative technologies for treating waste water were tested; chitosan flocculation, fermentation and ultrafiltration. These methodologies were chosen because investigators believed that they were capable of decreasing the organic load of clam processing effluent, and because they all produced potentially marketable products by which the industry could profit. In all respects, ultrafiltration was superior to both the other alternative technologies examined, and to standard biological treatment. All three alternative methodologies reduced organic load, however, ultrafiltration resulted in the greatest reduction. The final product of ultrafiltration proved to be more marketable than the products of chitosan flocculation or fermentation. And finally, capital expenses, operating costs and the payback period for ultrafiltration were significantly less than for either standard biological treatment or the other alternative technologies tested. Project investigators believe that the use of ultrafiltration for selected waste water streams, such as post-grind wash water, can divert the majority of a clam plant's "pollution" into a profitable flavor product. In many cases, the organic load remaining in the untreated streams will be acceptable to many municipal sewage treatment systems.

GRANT NUMBER: NA46FD0332 NMFS NUMBER: 93-NER-011
REPORT TITLE: Harvesting the Value-Added Potential
of Atlantic Hagfish, *Myxine glutinosa*
AUTHOR: Hultin, Herb; Kelleher, Stephen; Kuenstner, Sue
and Nardi, George
PUBLISH DATE: April 1, 1996
AVAILABLE FROM: National Marine Fisheries Service
Northeast Region
One Blackburn Drive
Gloucester, MA 01930-2298
PHONE: (978) 281-9267

ABSTRACT

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Stocks of traditionally fished species off the New England coast have declined over the past few years. As a result, many fishermen are targeting alternate or underutilized species such as dogfish, skate, sea urchins, and now, Atlantic hagfish. In 1993, a small fishery for Atlantic hagfish, *Myxine glutinosa*, was established on the East Coast. However, the way the market is currently set up, much of the profit from this fishery is being realized overseas, rather than in the region where the fish are being trapped. Atlantic hagfish are packed whole and sent to Korea where the skins are tanned and stitched in the production of "eelskin" leather, and the meat is sold for human consumption.

The primary goal of this project was to capture a previously untapped corner of the market for Atlantic hagfish, and to retain more of the financial benefits of the fishery in the New England region. This was accomplished by developing a positive identity for New England hagfish leather, developing prototype food products for hagfish meat, and by collecting data which will be useful in future management of this fishery.

GRANT NUMBER: NA46FD0339 NMFS NUMBER: 93-NER-055
REPORT TITLE: Population Structure of the Arkshell Clams
Noetia ponderosa and *Anadara ovalis* in the
Oceanside Lagoons and Tidal Creeks of Virginia
and Implications for Fisheries Management
AUTHOR: McGraw, Katherine A.; Castagna, Michael and
Dennis, Sally D.
PUBLISH DATE: April 5, 1996
AVAILABLE FROM: National Marine Fisheries Service
Northeast Region
One Blackburn Drive
Gloucester, MA 01930-2298
PHONE: (978) 281-9267

ABSTRACT

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A survey was conducted in the oceanside lagoon system along the Eastern Shore targeting two species of arkshell (blood) clams, *Noetia ponderosa* and *Anadara ovalis*. Data were collected on density, abundance, habitat preference, and mortality rates for both species of blood clams, as well as some ancillary data on the hard clam, *Mercenaria mercenaria*. The study provides baseline data for establishing management practices and regulations for the blood clam fishery.

GRANT NUMBER: NA46FD0352 NMFS NUMBER: 93-AKR-002
REPORT TITLE: A Low-Cost Rearing Method for Alaskan Oyster
Spat
AUTHOR: University of Alaska Fairbanks, School of
Fisheries and Ocean Sciences
PUBLISH DATE: February 1, 1997
AVAILABLE FROM: National Marine Fisheries Service
Alaska Region
709 W. 9th Street, 4th Floor
P.O. Box 21668
Juneau, AK 99801
PHONE: (907) 586-7224

ABSTRACT

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Pacific oyster *Crassostrea gigas* spat were reared in an outdoor seawater pond where artificial upwelling and the addition of agricultural fertilizers were used separately and together to culture phytoplankton. Spat reared in a nearby fiord served as controls to see if shell and meat growth was accelerated in the nutrient enriched habitat. The phytoplankton taxa in the pond was continually changing throughout each 2 week assay, as did the cell abundance. In the fiord phytoflagellates dominated the summer growth assays. In the nutrient enriched pond phytoflagellates and diatom co-existed. In the pond phytoplankton were 2 to 21 times more abundant than in the fiord. Neither phytoplankton abundance nor their taxa present in the pond were predictably related to the fertilization method. In 5 of the 6 growth assays oyster spat reared in the fertilized pond had more rapid tissue weight gains than those reared in the fiord, and in 4 of 6 trials the phytoplankton community in the fertilized pond supported larger increases in shell length. In the fertilized pond the shells of oyster spat grew in an average of 0.1 mm.d for all of the growth assays, vs 0.06 mm.d for spat reared in the fiord.

GRANT NUMBER: NA46FD0353 NMFS NUMBER: 93-AKR-008
REPORT TITLE: Bioeconomics and Management of a Mixed Stock
Sequential Fishery Under Uncertainty
AUTHOR: Criddle. Keith R.
PUBLISH DATE: February 1, 1996
AVAILABLE FROM: National Marine Fisheries Service
Alaska Region
P.O. Box 21668
Juneau, AK 99802
PHONE: (907) 586-7224

ABSTRACT

Management of the salmon fishery on the Yukon River is complicated by the lack of accurate preseason forecasts, limited information on the determinants of the dynamics of unit stocks, harvesting effort directed at a mixture of stocks, and the sequential availability of the returning fish to subsistence, commercial, and sport fishermen in Alaska and Canada. A static stochastic simulation model was developed and used to examine the consequences of eight alternative strategies for setting commercial catch limits. The merit of each strategy was judged by three criteria: probability of satisfying escapement objectives, probability of simultaneously satisfying escapement and subsistence harvest objectives, and the probability of also reaching commercial harvest goals. The results indicate that subsistence and commercial catch objectives for chinook and coho salmon cannot be consistently achieved in the upper Yukon River unless catches in the lower Yukon River are restricted below their 1980-1994 average. The model indicates that even when lower Yukon commercial catches of chum salmon are reduced below their 1980-1994 average, it may not be possible to meet escapement objectives in the upper Yukon River drainage. In addition, the simulation model was used to explore the effects of reduced interception of Yukon River chum salmon and increased escapement of chinook salmon into Canada. Even with greatly increased returns of chum salmon, catch and escapement goals for the upper Yukon cannot be consistently achieved without restricting fisheries on the lower Yukon. Similarly, increased escapements of chinook to Canada cannot be consistently achieved without restricting commercial fisheries in the lower Yukon to catches below their recent (1980-1994) average.

GRANT NUMBER: NA46FD0396 NMFS NUMBER: 93-NWR-022
REPORT TITLE: Evaluation of Mechanical Methods and Herbicide/
Adjuvant Treatments for the Effective Control
of *Spartina spp.*
AUTHOR: Norman, Michael and Patten, Kim
PUBLISH DATE: July 23, 1996
AVAILABLE FROM: National Marine Fisheries Service
Northwest Region, 7600 Sand Point Way, NE
BIN C15700, Bldg. 1
Seattle, WA 98115
PHONE: (206) 526-6117

ABSTRACT

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Spartina is an exotic, perennial, noxious weed that has colonized 10% or 4700 acres of Willapa Bay intertidal mudflats and is spreading geometrically. *Spartina* displaces native plants (eelgrass) and animals (shellfish, salmon, shorebirds, and waterfowl) and has unknown impacts on crab production. *Spartina* threatens the economic base of estuarine communities in Pacific County, Washington, and the historical habitat for numerous species. The objective of this study was to determine the cost-effectiveness of the *Spartina* control options outlined in the Integrated *Spartina* (*Spartina alterniflora* Loisel.) Management Plan adopted by the Pacific County noxious Weed Board. Control efforts evaluated included hand-pulling, mowing, combined mowing/herbicide treatments, and various herbicide applications. Results indicate the ranking of cost-effective treatments to be: hand-mowing > herbicide applications alone > hand-mowing followed by herbicide applications > hand-pulling. The most cost-effective method was a hand-mowing treatment that controlled *Spartina* 95% at a cost of \$312/A. The most cost-effective herbicide application was a hand-held, wiping treatment that controlled *Spartina* 84% at a cost of \$300/A. The most cost-effective combined mowing/herbicide treatment controlled *Spartina* 93% at a cost of \$368/A. All of these ground-based, hand-held treatments, however, can only control small acreages. The prioritized ranking of optimal cost-effectiveness of herbicide applications indicate the following: 1) month of application, July > June > August, 2) application methods, hand-held wipe > hand-held backpack > simulated aerial, and 3) adjuvants, X-77 > LI 700. Simulated aerial treatments were ineffective. Based on the current, large, established infestation in Willapa Bay, many regional authorities believe that aerial application is the only large-acreage control effort that can significantly arrest the continued spread of *Spartina*. Environmentally-sound, cost-effective, aerial applications need to be identified and implemented immediately. This can be most readily accomplished through the evaluation of the effects of other environmentally-sound adjuvants on the control of *Spartina*.

GRANT NUMBER: NA46FD0397 NMFS NUMBER: 93-NWR-012
REPORT TITLE: Estimates of Effective Fishing Effort for the
U.S. West Coast Groundfish Trawl Fishery
AUTHOR: Sampson, David B.
PUBLISH DATE: December 1996
AVAILABLE FROM: National Marine Fisheries Service
Northwest Regional Office
7600 Sand Point Way, NE
Seattle, WA 98115
PHONE: (206) 526-6115

ABSTRACT

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In this study, logbook data from the bottom trawl fisheries of California and Washington were used to estimate effective, standardized catch-per-unit-effort (CPUE) for thirteen groundfish species: ten species off each state. The data, which included skippers' tow-by-tow estimates of retained catch, were compared with landing receipts to remove inaccurate information; trips influenced by regulatory trip limits were also excluded. From the remaining data a subset for each state was chosen for detailed analysis to identify influential factors, to develop simplified statistical models, of catch rates for each species, and to identify boats that could be used for estimating standardized CPUE. Excluded from the standardized analyses were boats that did not operate throughout the study period, and areas in which there was limited fishing.

The selected data were analyzed in a stepwise manner using generalized linear models for catch rates to measure the importance of the factors Year (1985-91 in CA and 1986-92 in WA), Season (bimonthly intervals) Boat (23 boats per state), Net type (generic bottoms trawl versus trawl with roller gear), Latitude (20 minute intervals), and Depth (40 fathom intervals). Because for each species there were large numbers of tows with catches that were zero, catch rates were modeled using a delta-lognormal distribution; the numbers of tows with zero catch were treated as binomial random variables and the catch rates for the non-zero tows were treated as lognormal random variables.

The process of data verification and screening resulted in the exclusion of data from about half the fishing trips. The data subsets that were subjected to the detailed analyses consisted of tow-by-tow catch rates (lb/hr) from 63,532 tows from the California data and 53,273 tows from the Washington data. In the logistic regression analyses of the zero catch tows, essentially all factors were found to be highly significant ($P < 1\%$) for all species from both states. Depth was the first or second most influential factor in 19 of the 20 different state-species combinations, and Boat was the first or second most influential factor in 18 combinations. In the analyses with pairwise interactions, the Year-Boat interaction was the first or second most influential interaction for 14 of 20 combinations. In the

GRANT NUMBER: NA46FD0397 (Cont'd.)

Analyses with lognormal models of the non-zero tows, essentially all factors were found to be highly significant ($P < 1\%$) and Boat was the first or second most influential factor in 19 of the 20 combinations, Depth was the first or second most influential factor in 6 combinations, and the Year-Boat interaction was the first or second most influential interaction for 15 of 20 combinations. For each state and species estimates of annual fishing power coefficients were examined to identify boats with stable fishing power.

To estimate standardized CPUE for each species for individual areas (defined by the factors Latitude and Depth), the simplified statistical models, developed from the detailed analyses, were applied to data from the top 40 boats for each species from each state. The data were further restricted to those areas that had been fished in during the entire study period. The estimates of area-specific CPUE, which was defined as the average catch (lb per hour of towing for those boats selected as the standards, were the average to estimate the effective, standardized CPUE for each species. In the estimates from the California data there were substantial declines indicated for rex sole, moderate declines for Dover sole, and slight declines for thornyheads; and there were moderate increases indicated for petrale sole and lingcod. In the estimates from the Washington data there were substantial declines indicated for rockfish, large declines for sablefish, and slight declines for lingcod; and there were moderate increased indicated for English sole.

Estimates of effective trawl fishing effort were derived for each state and species by dividing total reported trawl landings by the estimates of effective, standardized CPUE.

GRANT NUMBER: NA46FD0399 NMFS NUMBER: 93-NWR-026
REPORT TITLE: Toxicity of *Heterosigma* to Fish
AUTHOR: Taub, Dr. Frieda B.; University of Washington
PUBLISH DATE: February 29, 1996
AVAILABLE FROM: National Marine Fisheries Service
Northwest Region
7600 Sand Point Way, NE
Seattle, WA 98115
PHONE: (206)-526-6115

ABSTRACT

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This proposal addresses the cause of *Heterosigma* blooms and their variable toxicity to fish. *Heterosigma* blooms in 1989-1990 killed more than 2 million pen-reared salmon worth \$8 million dollars in Western Washington; fish killing blooms in many other parts of the world have also been reported. In this project, a new mechanism for causing the dense surface blooms was described. In vertical columns, when distilled water was added to the surface, *Heterosigma* cells became concentrated in surface regions of lesser salinity water (Hershberger, 1995). Although this behavior was demonstrated in laboratory cultures, the conditions seem consistent with those observed during field blooms. A fish kill involving wild, free swimming salmon was associated with a *Heterosigma* bloom at Case Inlet, Allyn, WA in late September 1994; data were collected on vertical distribution of temperature, salinity, pH, nutrients, and Secchi depth. The general hypothesis we are testing is that nutrient deficiencies or imbalances induce (otherwise non-toxic) *Heterosigma* to become toxic, or encourage the competitive dominance of toxic strains. We succeeded in obtaining phosphorous limited cells, but no toxicity was demonstrated. Nitrate-limited cultures have not been obtained; cells have died when introduced to medium with less than 500 uM nitrate, whereas Puget Sound rarely exceeds 40 uM nitrate. Cells rinsed free of nitrate did not demonstrate toxicity. We have also studied the effects of iron limitation, salinity, and ultra-violet light on growth and toxicity. Because nitrate levels were unusually low (0.22 uM) during the fish kill, we are continuing to investigate N deficiency, as well as other stresses associated with surface bloom formation.

GRANT NUMBER: NA46FD0417 NMFS NUMBER: 93-NWR-014
REPORT TITLE: Evaluation of Fish Excluder Technology to
Reduce Finfish Bycatch in the Ocean Shrimp
Trawl Fishery
AUTHOR: Hannah, Robert W.; Jones, Stephen A. and
Hoover, Vicki J.
PUBLISH DATE: April 1, 1996
AVAILABLE FROM: National Marine Fisheries Service
Northwest Region
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PHONE: (206) 526-6117

ABSTRACT

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The project evaluated the effectiveness of four types of fish excluders (3-, 4-, and 8-inch mesh and the Nordmore Grate) in the ocean shrimp (*Pandalus jordani*) trawl fishery. Assessment techniques included underwater video equipment and comparative fishing experiments employing side by side comparisons on double rigged shrimp vessels. All four fish excluders worked well in avoiding the catch of large fish, with the Nordmore Grate and 3-inch mesh excluding 100 percent of adult hake. All experimental devices excluded small fish but at a lesser rate. Shrimp loss for the Nordmore Grate and 3-inch soft panel gear ranged from 0-10 percent, while the other devices experienced loss rates of 15-31 percent. Overall, all of the soft panel fish excluders provided to be effective in reducing bycatch; however, shrimp loss rates must be minimized to encourage greater usage by the fleet. A videotape summarizing project activities and results is available.

GRANT NUMBER: NA46FD0418 NMFS NUMBER: 93-NWR-023
REPORT TITLE: Use of the Red Macroalga, *Palmaria mollis*, in
Improving Hatchery Seed Production of the Red
Sea Abalone, *Haliotis rufescens*
AUTHOR: Langdon, Christopher and Buchal, Michael;
Hatfield Marine Science Center, Oregon State
University, Newport, OR 97365
PUBLISH DATE: June 1, 1996
AVAILABLE FROM: National Marine Fisheries Service
Northwest Regional Office
7600 Sand Point Way, NE
Seattle, WA 98115
PHONE: (206) 526-6115

ABSTRACT

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This study was designed to examine the potential use of dulse (*Palmaria mollis*) in the nursery production of red abalone (*Haliotis rufescens*). Production of abalone seed for farmers or enhancement programs is generally dependent on settlement of larvae and culture of early juveniles using diatom films on the surfaces of culture containers. The quality of these diatom films is difficult to maintain under nursery conditions and high mortalities of post-metamorphic juveniles is commonly reported by abalone culturists. We found that conditioning broodstock on a diet of dulse instead of kelp, *Nereocystis leutkeana*, resulted in the production eggs of significantly higher protein and lipid content and higher hatching success rates. Larvae from parents conditioned on dulse metamorphosed at significantly higher success rates than larvae from parents conditioned on kelp. Furthermore, dulse could be successfully used instead of diatom coatings for larval settlement and growth of early juvenile abalone. Overall, we found that the use of dulse in nursery production of red abalone was an excellent alternative to the use of kelp and diatom films for conditioning broodstock and rearing early juveniles.

GRANT NUMBER: NA46FD0490 NMFS NUMBER: 93-NWR-021
REPORT TITLE: Identification of Disease Resistant Genes in
Fish to Monitor Disease Resistance in Fish
Stocks
AUTHOR: Leong, Dr. Jo-Ann C.; Oregon State University
PUBLISH DATE: August 6, 1996
AVAILABLE FROM: National Marine Fisheries Service
Northwest Regional Office
7600 Sand Point Way, NE
Seattle, WA 98115
PHONE: (206) 526-6115

ABSTRACT

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This proposal was a preliminary assessment of the genetic impact of the Mx locus of salmonid fish on disease resistance/susceptibility of both cultured and wild fish. Specifically, it focused on the characterization of Mx genes and their potential use as genetic markers to assess the genetic impact of diseases on fish. We have isolated an Mx gene from rainbow trout which is induced *in vivo* by IHNV infection. The Mx gene is highly conserved in animals and its expression can be correlated to disease resistance. Our major objective was to determine whether the expression of this gene correlated with resistance to IHNV and whether the trout Mx gene may be used as a genetic marker for disease resistance. Rainbow trout from Clear Springs Trout Co., with proven susceptibility or resistance to IHNV were analyzed for their ability to express the Mx gene and whether this expression could be correlated to disease resistance. We found that almost all fish were expressing Mx mRNA at 48 hours post injection. We did not find a significant number of fish that could not express one or both of the Mx transcripts or expressed a truncated Mx transcript as found in experiments with inbred mice. The restriction fragment length polymorphism (RFLP) for the Clear Springs' rainbow trout were also analyzed. The HpaI enzyme digestion yielded different RFLP patterns even between individuals from the same population of rainbow trout. To determine whether Mx gene probes may be used as disease resistance genetic markers as well as for RFLP analysis, different stocks of rainbow trout, chinook, coho and kokanee were collected and examined. Again, all fish were able to express two Mx transcripts upon Poly I:C induction. Unlike the mouse system, all salmonids investigated are able to express full length Mx mRNAs. We also found that there were different RFLP patterns among stocks of fish, but that some species of fish shared the same patterns.

GRANT NUMBER: NA46FD0491 NMFS NUMBER: 93-WO-019
REPORT TITLE: Rapid Methods to Differentiate Pathogenic
and Non-Pathogenic *Vibrio vulnificus* in
Molluscan Shellfish
AUTHOR: University of Florida
PUBLISH DATE: July 17, 1996
AVAILABLE FROM: National Marine Fisheries Service
1315 East West Highway
Silver Spring, MD 20910
PHONE: (301) 713-2358

ABSTRACT

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Vibrio vulnificus belongs to the autochthonous bacterial flora of warm estuarine waters. It can cause life-threatening extraintestinal disease in persons who have underlying illness, and who consume raw shellfish or contract wounds with estuarine water. The overall goal of this research was to develop rapid and accurate methods to predict the presence of pathogenic *V. vulnificus* in molluscan shellfish. Prior to this study, there was no method to predict which *V. vulnificus* strains in oysters caused human disease, the number of pathogenic strains in oysters, or estimates of the infectious dose. This research project found high genetic variation, via restriction fragment-length polymorphism (RFLP), among clinical and environmental isolates by pulsed field gel electrophoresis (PFGE) of bacterial DNA. In contrast, ribotype profiles showed greater homology. Interestingly, ribotype cluster C contained a low number of clinical isolates, and was also weakly virulent, compared to three other clusters. Some geographical relationship appeared to occur for Hawaiian isolates, since 83% were found in a single PFGE cluster. Individual oysters contained numerous *V. vulnificus* strains as defined by RFLP profile. In four instances, *V. vulnificus* isolates were obtained from human cases and/or matched oyster samples. Single *V. vulnificus* strains were found in the blood of all patients. In one, the patient isolate, as well as nine other PFGE type strains, were found in the implicated oysters; as predicted, only one strain appeared in blood. These data indicate that hypervirulent strains likely occur among mixed populations of *V. vulnificus* in oysters. In a separate experiment, a phagocytic cell assay, using line HL-60, did not correlate with *V. vulnificus* strain virulence in human cases or the mouse model.

GRANT NUMBER: NA46FD0493 NMFS NUMBER: 93-SWR-005
REPORT TITLE: Control of the European Green Crab in
California: Detection of Natural Enemies
AUTHOR: Kuris, Armand M.; Lafferty, Kevin D. and
Torchin, M.E.; University of California, Santa
Barbara, CA
PUBLISH DATE: February 12, 1996
AVAILABLE FROM: National Marine Fisheries Service
Southwest Regional Office
501 West Ocean Boulevard, Suite 4200
Long Beach, CA 90802-4018
PHONE: (562) 980-4033

ABSTRACT

We sampled the green crabs at sites where it was introduced (West Coast USA, East Coast USA, Tasmania) and in sites where it is native (Europe). Crabs achieved larger sizes in the introduced regions, suggesting that the crabs performed better ecologically. A comparison of limb loss among regions indicated no difference in the rise of predation between introduced and native regions. The presence of nemertean worms and parasitism by larval trematodes, acanthocephalans. Parasitic barnacles, on the other hand was substantially higher in Europe than in introduced regions. Trematodes and acanthocephalans were found in Europe and on the East Coast of the USA while nemerteans were found in Europe and on the West Coast of the USA. Rhizocephalan barnacles were only found in Europe. On the west coast, the nemertean worm transferred to the green crab from a native shore crab. We experimentally determined that this nemertean was capable of feeding on ovigerous green crabs in the field. In modeling the effect of a parasitic castrator, we found a direct association between the prevalence of a parasitic castrator and the degree to which the host population is reduced. This association was only direct at larger spatial scales where host recruitment was effectively closed. The parasitic castrator was limited to host populations with a minimum density. In some cases, time lags in the system led to extinction of the host population. Addition of parasites, as might be used in a biological control program also led to extinction of the host population. This might be augmented with a fishery for the host.

GRANT NUMBER: NA47FD0290 NMFS NUMBER: 93-SER-014
REPORT TITLE: Southeast Finfish Processing Activities of
Federally Managed Species, Particularly Reef
Fish, and Potential Impact of Regulation
AUTHOR: Keithly, Walter R. Jr., and Martin, Anthony
PUBLISH DATE: May 1997
AVAILABLE FROM: National Marine Fisheries Service
Southeast Region
9721 Executive Center Drive, North
St. Petersburg, FL 33702
PHONE: (813) 570-5324

ABSTRACT

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The general objective of the project was to provide an economic analysis of the southeast finfish processing sector, specifically the reef fish fishery, to evaluate the impact of different management options.

Results of the study indicate potentially large underreporting of reefish processing establishments (this does not include the underreporting by firms who report no reefish processing activities to NMFS). The underreporting was particularly apparent with respect to grouper and amberjack. For example, the 29 firms surveyed for purposes of analysis in this study reported 2.4 million pounds of processed grouper products and 459 thousand pounds of processed amberjack products. Total industry production of these two species, as reported in the NMFS processor database, equaled 2.5 million pounds and 270 thousand pounds, respectively. Hence, an incomplete survey of the population of identified firms accounted for essentially all of the grouper production reported by NMFS and almost twice the reported amberjack production. Two possible reasons or an amalgam thereof can be advanced for the apparent differences in overall production figures. First, identified processors could be underreporting actual processing figures in the NMFS end-of-the-year processor survey. Alternatively, processors may have overreported their actual production in the current survey. This second explanation seems somewhat remote, however, given the fact that many of the interviewed processors provided us with their actual records from which we derived annual and monthly figures. This calls into question the value of using NMFS processed finfish data for purposes of analysis and leads to the conclusion that mandatory reporting by processors may enhance the NMFS database.

GRANT NUMBER: NA47FD0293 NMFS NUMBER: 93-SER-026
REPORT TITLE: Bycatch of Atlantic and Shortnose Sturgeon in
the South Carolina Shad Fishery
AUTHOR: Collins, Mark R. and Smith, Theodore I.J.
PUBLISH DATE: January 1, 1996
AVAILABLE FROM: National Marine Fisheries Service
Southeast Region
9721 Executive Center Drive, North
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St. Petersburg, FL 33702
PHONE: (813) 570-5324

ABSTRACT

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The sturgeon bycatch of the commercial American shad set gill net fishery in Winyah Bay, South Carolina, was documented during the 1994 season. Examination of the bycatch from 2,561 net-hour of effort resulted in examination of 23 Atlantic (57-132 cm TL, nominal ages 207 years from pectoral spine sections) and 4 shortnose (57-90 cm TL) sturgeons, for a CPUE of 0.011 sturgeon/net-hr. Three Atlantic sturgeon were dead and four were lightly to severely injured. Total fishing effort in the study area during the 1994 season was estimated (using overflights) as 10,536 net-hr, permitting an expansion of the bycatch to an estimated 115 sturgeon (85 percent Atlantic), of which it was estimated that 123 died in the nets and 17 were released with varying injuries. All fish released alive were tagged, and two Atlantic sturgeon were recaptured. It was experimentally documented for Atlantic sturgeon that clipped barbels (for genetic samples) regenerate and wounds from pectoral spine removal (for ageing) heal readily. Substantial progress was made in establishing a computer database of all available information on the distribution and occurrence of sturgeons in south Carolina waters; more than 3,000 individuals are now on record.

GRANT NUMBER: NA47FD0296 NMFS NUMBER: 93-SER-034
REPORT TITLE: Reproduction of Flounder: Biotechnology for
Controlled Breeding in Fishery Enhancement and
Aquaculture
AUTHOR: Sullivan, Dr. Craig V.
PUBLISH DATE: November 20, 1997
AVAILABLE FROM: National Marine Fisheries Service
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PHONE: (813) 570-5324

ABSTRACT

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The goal of the project was to develop the techniques and knowledge required to establish the routine and controlled breeding of flounder for fishery enhancement and aquaculture. The specific objectives were to: 1) acquire the practical knowledge of reproduction necessary for advances in controlled breeding, 2) found captive broodstocks using reconditioned wild adults, 3) develop a controlled photothermal conditioning regime effective for stimulating gonadal growth and maturation, 4) induce spawning with mammalian gonadotropin hormone releasing hormone analogue (mGnRHa) chronically released from implanted pellets and 5) create 'clinical' non-destructive assays of maturation based on circulating levels of reproductive hormones and proteins.

Over 800 summer (*Paralichthys dentatus*) and southern (*P. lethostigma*) flounder were collected during the project. Fish readily accepted the cut bait and live forage within 3 weeks of captivity. Mortality from capture stress was usually low. On several occasions, broodstock were lost to mortality following capture or spawning. Protocols were modified to minimize stress by effectively assessing and treating animals during two handling events per year. A photothermal conditioning protocol (decreasing day length and water temperature) was developed to stimulate the onset and completion of gametogenesis. Fish induced to spawn in their first year in captivity were able to complete gonadal growth with decreasing water temperature alone.

Following a photothermal conditioning period, summer and southern flounder were successfully induced to ovulate with mGnRHa implants. Both GnRHa and the traditional treatment of injected carp pituitary extract (CPE) were effective for inducing ovulation but the repeated, daily CPE injections were very stressful to broodstock. Millions of eggs were strip spawned from both species during the project, but fertility was usually low and overall embryo survival and hatch rates were poor regardless of hormone treatment. Fish permitted one year of

GRANT NUMBER: NA47FD0296 (Cont'd.)

adaptation to captivity, tended to have fisher fertility rates than those spawned during the year of capture, but hatch rates were also low. For the first time, southern flounder were successfully induced to tank spawn using mGnRHa implants. Several million eggs were produced over a 41 day period, but hatch rates were less than 2%. Daily injections of hCG or CPE or mGnRHa implants failed to induce spermiation in either summer of southern flounder males. Males that were spermiating upon capture continued for several months.

Results of studies conducted to determine the environmental requirements for southern flounder larvae indicated no difference in survival or growth rates for 5-21 day old larvae stocked at 10, 20, 40 or 80 fish /L seawater. During metamorphosis, a greater percentage of larvae survived when stocked at 1 fish/L then 3 fish/L, but there was no difference in growth rate. Larvae exposed to 0 or 10 ppt salinity, during metamorphosis, had a significantly lower percent survival when compared to larvae maintained at 20 or 30 ppt. Approximately 6% of larvae stocked into outdoor nursery ponds were recovered as juveniles. The larvae grew rapidly from stocking through spring (March-June), but growth rates reached a plateau during the summer months (June-October). The results indicated that larvae are tolerant to a wide range of environmental conditions including high summer temperatures (30 C) and low D.O. (>5ppm).

We have surpassed the original project goals by delivering crucial information in the three key areas necessary for the enhancement of flounder fisheries and the development of a commercial mariculture industry. These are: 1) creation of founded flounder broodstocks and practical knowledge of their requirements for good husbandry, 2) the development of induced spawning protocols including the use of sustained release mGnRHa implants and the first demonstration of successful tank spawning of southern flounder, and 4) the establishment of hatchery and nursery techniques for extensive culture of larvae for production of juveniles. With the knowledge and techniques now in place, domestic broodstocks can be developed for year-round production of larvae for use in restocking programs, aquaculture or research.

GRANT NUMBER: NA47FD0351 NMFS NUMBER: 93-AKR-010
REPORT TITLE: Availability of Commercial Fish Species
as Food for Marine Mammals
AUTHOR: Norcross, Brenda L.
PUBLISH DATE: December 1, 1995
AVAILABLE FROM: National Marine Fisheries Service
Alaska Region
P.O. Box 21668
Juneau, AK 21668
PHONE: (907) 586-7224

ABSTRACT

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The objective of this project was to investigate the abundance of commercial fish species as a food supply for marine mammals, particularly Steller sea lions. Bottom trawl surveys were conducted near three rookeries in the Gulf of Alaska. Small demersal fishes were targeted within foraging range of the sea lion rookeries on Akun, Atkins and Marmot Island. The most abundant species in the total catch from all gear types were rock sole, northern sculpin, Pacific halibut, walleye pollock, butter sole, Aleutian alligator fish, arrowtooth flounder, and fourhorn poacher. Catch-per-unit-effort (CPUE) was estimated as number of fish per 10 min. tow and was found to differ among gear types and mesh sizes. Species composition and abundances differed significantly among rookeries when CPUE's from the most frequently used gear type were compared. Rock sole, mostly age-0 fish, was the most abundant species at Akun Island, whereas northern sculpin was most abundant at Atkins and Marmot Islands. The observed patterns of CPUE by sampling location indicated a decreasing trend in CPUE from west to east for most species. Observed species composition and abundances do not reflect all prey available to juvenile Steller sea lions within feeding range of the rookeries because only trawlable areas were sampled and because the size range of fishes sampled is smaller than the average size of prey in sea lion stomachs. Nevertheless, differences are believed to reflect real differences in prey availability among rookeries that potentially affect sea lion feeding.

GRANT NUMBER: NA47FD0391 NMFS NUMBER: 93-WO-033
REPORT TITLE: Framework for Industry Consideration
of Incidental Bycatch in Pelagic
Longline Fisheries
AUTHOR: Hoey, John J.
PUBLISH DATE: September 4, 1996
AVAILABLE FROM: National Marine Fisheries Service
National Program Office, F/SF2
1315 East West Highway
Silver Spring, MD 20910
PHONE: (301) 713-2358

ABSTRACT

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The objective of this project was to provide baseline information to members of the longline fishing industry to encourage practical suggestions for operational changes that could minimize bycatch. Data from over 1,500 U.S. set records and over 5,400 Japanese set records were analyzed and summarized by region for catch composition, disposition characteristics, survival rates, and gear and operational features. The summary information was provided to fishermen at workshops conducted under the grant, at the Bycatch Symposia in Seattle and Rhode Island, and at the Blue Water Fishermen's Association's annual meeting. These data allowed fishermen to compare their experiences against other fishery operations. Active participants in the pelagic longline fishery were surveyed for their opinions on practical options to reduce bycatch with minimal economic impact, and their responses were quantified. This project established the foundation for industry participation in the management process for developing mechanisms to address bycatch issues.

GRANT NUMBER: NA47FD0428 NMFS NUMBER: 93-WO-039
REPORT TITLE: Distribution of Norwalk Virus in Shellfish
AUTHOR: Atmar, Robert L., M.D., Baylor College of
Medicine
PUBLISH DATE: June 30, 1997
AVAILABLE FROM: National Marine Fisheries Service
National Program Office
1315 East-West Highway
Silver Spring, MD 20910
PHONE: (301) 713-2358

ABSTRACT

The objective was to use polymerase chain reaction (PCR) and nucleic acid-based transcription and hybridization technologies to detect and follow the course of Norwalk virus (NV) progression within shellfish after bioaccumulation from environmental sea water. The specific goals were to determine the tissue distribution of NV in oysters and clams and to determine whether tissue-associated viruses adversely affect shellfish depuration effectiveness. Long-term, the project is expected to lead the exploration of practices that will enhance depuration effectiveness by determining which practices promote elimination of tissue-associated viruses. The eastern oyster, *Crassostrea virginica*, and the hard shell clam, *Mercenaria mercenaria*, were exposed to varying concentrations of NV for 4-24 hour bioaccumulation times, and tissues including the stomach, digestive diverticulum, adductor muscle, and hemolymph cells were examined for the presence of virus, using RT-PCR, *in situ* transcription, and *in situ* PCR techniques. Duration effectiveness was compared to a bacterial indicator standard, *E. coli*, in experiments with *C. virginica*. NV was present in all oyster and hardshell clam tissues examined following bioaccumulation. NV was depurated less efficiently than *E. coli* from oysters.

GRANT NUMBER: NA47FD0429 NMFS NUMBER: 93-WO-038
REPORT TITLE: Development of a Highly Sensitive Probe for Use
in the Detection of Toxins Responsible for
Diarrhetic Shellfish Poisoning (DSP)
AUTHOR: Honkanen, Richard E.
PUBLISH DATE: August 5, 1995
AVAILABLE FROM: National Marine Fisheries Service
National Program Office
1315 East West Highway
Silver Spring, MD 20910
PHONE: (301) 713-2358

ABSTRACT

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This study investigates the potential for developing an enzyme based assay (PP2A-assay) into a rapid and reliable test for the detection of DSP-toxins in shellfish. The PP2A-assay is based on a unique pharmacological property of the major DSP-toxins, okadaic acid (OA) and dinophysistoxin-1(DTX-1), which bind to and inhibit the activity of certain protein phosphatases (i.e. PP1 and PP2a). Since the harmful effects of OA and DTX-1 originate from their ability to inhibit protein phosphatases, inhibition of PP2A/PP1 activity correlates well with toxicity. The initial step in developing the PP2A assay was to determine the maximal sensitivity and reliability under highly controlled conditions. Studies with pure toxins indicate that the PP2A assay is capable of detecting as little as 10-20 pg of OA or DTX-1. Next, the sensitivity and reliability of the PP2A assay for detecting DSP-toxins in a whole shellfish matrix was assessed with a series of spike recovery experiments. Results from these experiments indicated that the assay was effective at detecting toxins in crude methanol extracts of whole oysters. To further validate the effectiveness of the PP2A assay, a direct comparison was made with a HPLC-based method. Again, the PP2A assay proved to be sensitive and reliable. In an attempt to make the assay more cost effective, we then engineered a clone of PP2A obtained from bovine brain for the production of recombinant PP2A in *E. coli*. To date, we have been able to produce a clone expressing PP2A; however, the yield is not yet optimal. We have begun to assess methods for optimizing the yield of recombinant PP2A and maintaining stability of expression with passage. In conclusion, the PP2A assay looks promising for development into a reliable method of detecting DSP-toxins in shellfish. If employed, such a test should benefit the shellfish industry through the increased consumer confidence provided by a reliable method of toxin monitoring and the general public through improved seafood safety.

GRANT NUMBER: NA47FD0447 NMFS NUMBER: 93-WO-007
REPORT TITLE: Detection and Quantification of Toxic
Dinoflagellate Species Using Molecular Probes
AUTHOR: Anderson, Donald M.
PUBLISH DATE: February 28, 1997
AVAILABLE FROM: National Marine Fisheries Service
Johnson Laboratory
219 Fort Johnson Road
Charleston, SC 29412
PHONE: (803) 762-8526

ABSTRACT

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The objective of the project was to develop species-specific or strain-specific assays for harmful algal species. Polyclonal antibodies (PABs) to *Alexandrium tamarense* were produced and were then affinity purified to minimize cross-reactions. The initial production of PABs was highly successful. Affinity purification required two different approaches, i.e., positive selection of the anti- *Alexandrium* antibodies and negative adsorption with subsequent removal of the cross-reacting antibodies. The negative adsorption method appeared to be the best approach; however, even after adsorption, significant cross-reactions with *Pyrodinium* remained. Therefore, negative adsorption proved to be as challenging and unfruitful as the positive selection methods for purified antibodies. Despite considerable effort, the project did not result in a usable, purified polyclonal antibody. It is now clear that monoclonal antibodies offer the best chance of producing highly specific antibodies to *Alexandrium*.

GRANT NUMBER: NA56FD0010 NMFS NUMBER: 93-SWR-008
REPORT TITLE: Parasitological Examination of Wasting Disease in
Black Abalone, *Haliotis cracherodii*
AUTHOR: Shields, Jeffrey D. and Perkins, Frank O.
PUBLISH DATE: March 31, 1997
AVAILABLE FROM: National Marine Fisheries Service
Southwest Region
501 West Ocean Boulevard, Suite 4200
Long Beach, CA 90802-4213
PHONE: (562) 980-4000

ABSTRACT

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Black abalone in southern California are afflicted with chronic intestinal infections of a rickettsia-like organism that causes a debilitating and fatal withering syndrome. The hematology of withered animals indicated that cellular degradation and apoptosis occurred in tandem with the decline and catabolism of abalone tissues. Two types of hemocytes were found in the hemolymph. Type I and Type II Hyalinocytes were distinguished by subtle differences in their cytoplasmic vesicles. Densities of both types hemocytes declined in abundance, and small, presumptive stem cells increased in abundance with the progression of the disease. No circulating granulocytes were present in hemolymph; but serous cells were present as fixed granulocytes in hemal spaces. Cellular inclusions, dying cells, and vacuolate cells increased in abundance with the disease. An evaluation of cellular immunity resulted in disparate findings associated with serum levels and types of buffer used. In the presence of micronutrients, and divalent metal ions, however, hemocytes from infected abalone showed increased degrees of phagocytosis (percent phagocytosis, and number of yeast particles per hemocyte) compared to hemocytes from uninfected animals. Experimental transmission of the disease was effected in healthy, unexposed abalone held together with asymptomatic, exposed abalone. Clinical signs of infection appeared after 180 days of cohabitation. The chronic nature of the disease progressed relatively unnoticed until 6 to 8 months infected abalone began to show signs of withering. The withered condition represented an end stage of the disease and probably resulted from starvation caused by rickettsial disruption of the digestive processes.

GRANT NUMBER: NA56FD0011 NMFS NUMBER: 93-SWR-009
REPORT TITLE: Population Genetics of Adult Red Sea Urchins,
Strongylocentrotus franciscanus, along the
Pacific Coast
AUTHOR: Regents of the University of California, Santa
Barbara, CA
PUBLISH DATE: January 31, 1996
AVAILABLE FROM: National Marine Fisheries Service
Southwest Regional Office
501 West Ocean Boulevard, Suite 4200
Long Beach, CA 90802-4018
PHONE: (562) 980-4033

ABSTRACT

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The primary objective of the project was to determine the number of genetically distinct stocks of adult red sea urchins along the Pacific coast as indicated by possible variations in the DNA sequences of individuals sampled from six sites. The DNA results show that the binding gene of adult red seas urchins has a highly variable region and that the high allelic variation in this section exhibits a high non-synonymous:synonymous ratio. These results suggest that all adult red sea urchin populations along the Pacific coast are genetically distinct.

GRANT NUMBER: NA56FD0071 NMFS NUMBER: 93-NWR-013
REPORT TITLE: Offshore Aquaculture Harvest and Transport
Concept; Feasibility and Development
AUTHOR: Loverich, Gary F.; Swanson, Kurt and Gace,
Langley; Ocean Spar Technologies, LLC
PUBLISH DATE: December 31, 1996
AVAILABLE FROM: National Marine Fisheries Service
Northwest Regional Office
7600 Sand Point Way, NE
Seattle, WA 98115
PHONE: (206) 526-6115

ABSTRACT

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To reduce the operating costs of sea farming offshore, a means to quickly and efficiently crowd fish in a sea cage for harvest or transport was investigated. Additionally, transporting these same fish over longer distances of exposed water without undue stress, risk or operational hazard was investigated. A new sea cage design called Sea Station (TM), satisfied these requirements. By simply inverting the taut net, fish were crowded to an opening in the side of the cage and exited into a harvest pen. The Sea Station can safely be towed at a speed of 51 cm./sec. without changing shape or volume enclosed. Fish behavior was observed and recorded for all operations and fish stress levels during the harvest appeared to be very low.

GRANT NUMBER: NA56FD0618 NMFS NUMBER: 95-NWR-025
REPORT TITLE: Reduction of Seabird Bycatch in Salmon Drift
Gillnet Fisheries
AUTHOR: Melvin, Edward F.; Conquest, Loveday L. and
Parrish, Julie K.
PUBLISH DATE: June 15, 1997
AVAILABLE FROM: National Marine Fisheries Service
Northwest Region
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PHONE: (206) 526-6117

ABSTRACT

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We compared entanglement rates of seabirds and marine mammals and catch rates of salmon among up to three experimental gear treatments and a control (nylon monofilament netting) and among three time-of-day categories in two Washington non-treaty salmon fisheries: the 1996 sockeye fishery in Management Area 7, the San Juan Islands vicinity of North Puget Sound, and the 1995 fall chum fishery in Management Area 10, South Puget Sound. Results of this study identify three basic tools that can be used to reduce seabird bycatch in these fisheries: abundance based or ecosystem management, traditional monofilament nets modified to include a 20 Mesh visual barrier, and time-of-day. Management recommendations were developed to reduce seabird bycatch in drift gillnet fisheries through institutional and fishery changes. For the first time tools have been developed and implemented to reduce seabird bycatch in nearshore gillnet fisheries.

GRANT NUMBER: NA56FD0621 NMFS NUMBER: 95-WO-007
REPORT TITLE: Taura Syndrome of Maine Penaeid Shrimp:
Development and Application of Molecular
Detection Methods of TSV from Domestic Shrimp
Aquaculture and Evaluation of Challenge Studies
in Gulf of Mexico Species
AUTHOR: Lightner, Dr. Donald V.
PUBLISH DATE: December 12, 1996
AVAILABLE FROM: National Marine Fisheries Service
Southwest Region Science Center
Galveston Laboratory
4700 Avenue U
Galveston, TX 77551
PHONE: (409) 766-3516

ABSTRACT

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Taura Syndrome Virus (TSV) was the topic of this 1-year research project. New knowledge on the biology and host range of TSV was developed as a result of the research effort. The virus was characterized and tentatively placed in the family *Picornaviridae*. Modern detection methods for the virus were developed, including serological methods using fluorescent and enzyme-linked detection methods with polyclonal and monoclonal antibodies to TSV antigens. Nonradioactive cDNA probes were developed and applied to *in situ* hybridization assays for TSV in histological sections. A PCR method was developed for TSV and successfully applied to the detection of the virus in fresh hemolymph samples. Native shrimp species were challenged with TSV. The white shrimp, *Penaeus setiferus*, was found to be highly susceptible to infection and disease in the postlarval stages, while juveniles of the species were found to be relatively resistant. In contrast, postlarval and juvenile stages of the brown shrimp, *P. aztecus*, and the pink shrimp, *P. duorarum*, were found to be refractory to TSV.

GRANT NUMBER: NA57FD0009 NMFS NUMBER: 93-SWR-007
REPORT TITLE: Evaluation of Nucleic Acid Probes for
Identifying Domoic Acid-Producing
Pseudo-nitzschia Species
AUTHOR: Scholin, Christopher A.
PUBLISH DATE: July 15, 1996
AVAILABLE FROM: National Marine Fisheries Service
Southwest Region
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ABSTRACT

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Some but not all marine pennate diatoms of the genus *Pseudo-nitzschia* are associated with the production of domoic acid, the causative agent of amnesic shellfish poisoning (ASP). Distinguishing between potentially toxic and nontoxic representatives of this genus is time-consuming and often difficult. In an effort to speed and ease species identifications a suite of ribosomal RNA-targeted DNA probes were devised for identifying *P. americana*, *P. fraudulenta*, *P. heimii*, *P. pungens*, *P. australis*, *P. delicatissima*, *P. multiseriata* and *P. pseudodelicatissima*. Of those species the latter four as they occur in North America are considered potentially toxic, with the greatest public health threat likely to arise from blooms of *P. australis*, *P. multiseriata* and *P. pseudodelicatissima*. Fluorescently labeled probes for all species were applied using a filter manifold system with sequential addition of reagents; the resulting filters were transferred to a conventional microscope slide and viewed using epifluorescence microscopy. Labeled cells were enumerated and by knowing the volume of water filtered it was possible to estimate the abundance of particular *Pseudo-nitzschia* species in cultured and field samples. A colorimetric "dipstick-type" assay was also devised for detection of *P. australis*, *P. multiseriata*, *P. pseudodelicatissima* and *P. pungens* in a single sample, simultaneously, using a semi-automated processor. This portion of the work was done in collaboration with MicroProbe Corp. In this case, cells from cultured or field samples were collected onto a filter then lysed (homogenized). The cell lysate was transferred to a custom instrument for automated processing. The end result was a colorimetric reaction, the intensity of which was proportional to the abundance of targeted species in the original sample. Both methods of probe application (whole cell fluorescence and dipstick colorimetry) are promising and rapid means by which one might detect and quantify *Pseudo-nitzschia* species as they occur in natural samples. Neither method is technically demanding nor expensive. More work is required to test the utility of the

GRANT NUMBER: NA57FD0009 (Cont'd.)

methods for routine plankton monitoring and their applicability

for detecting a wider range of aquatic-borne species that are of public health or economic concern.

GRANT NUMBER: NA57FD0030 NMFS NUMBER: 93-SER-023
REPORT TITLE: Location and Stock Identification of Spawning
Aggregations of Gag, *Mycteroperca microlepis*,
along the Southeast Coast of the United States
AUTHOR: South Carolina Department of Natural Resources
PUBLISH DATE: August 29, 1996
AVAILABLE FROM: National Marine Fisheries Service
Southeast Region
9721 Executive Center Drive, North
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St. Petersburg, FL 33702
PHONE: (813) 570-5324

ABSTRACT

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The goal of this project was to use rapid survey methods to locate gag (*Mycteroperca microlepis*) spawning aggregations and determine the relationship between spawning adults and juveniles recruited to nursery habitats. Using side-scan sonar to locate, and underwater TV (UWTV), and plankton sampling to confirm, spawning aggregations were located. The identity of stocks was determined by tagging and genetic work. DNA amplification techniques were used to identify individuals from specific spawning sites, and to determine if juveniles in estuarine nursery habitats can be identified as progeny from particular spawning aggregations. Finally, the project determined sex ratios of gag in spawning aggregations throughout the South Atlantic Bight. The data indicated that gag are spawning north of Florida. Large adult gag in spawning condition were collected at the shelf edge off Charleston, South Carolina. UWTV noted the presence of few gag during the spawning season, but occasional groups were seen at the shelf edge. Plankton tows collected only one *Mycteroperca spp.* larva. Genetic analysis indicated no clear pattern of stock structure in gag, and suggested year class differences in microsatellite allele frequencies. To resolve this, a large sample size (at least 50 fish from each year class and from each area) and ageing data are needed. Sex ratios of gag off the southeastern Atlantic coast have changed over the last 20 years, perhaps as a result of fishing pressure.

GRANT NUMBER: NA57FD0033 NMFS NUMBER: 93-SER-004
REPORT TITLE: To Introduce New TED Designs to the Southeastern
Atlantic Shrimp Fleet and to Compare their
Bycatch Exclusion Rates and Shrimp Retention
Rates with those of Established TED Designs
AUTHOR: Vendetti, Richard A.; Overman, Robert G.;
Parker, Lindsey G. and Harrington, David L.
PUBLISH DATE: March 1, 1996
AVAILABLE FROM: National Marine Fisheries Service
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PHONE: (813) 570-5324

ABSTRACT

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In response to increasing numbers of Leatherback turtles on the southeastern Atlantic shrimp grounds and a similar increase in strandings, emergency rules were implemented in the spring of 1993. Because no existing TED could accommodate such large specimens, the National Marine Fisheries Service (NMFS) allowed modifications to the TED exit hole that would enable large sea turtles to escape.

Exit hole modifications are critical to fish reduction and shrimp retention. This project assesses the shrimp retention and fish exclusion rates of TEDs modified to exclude Leatherback turtles. This project also made every attempt to involve the commercial shrimping industry in the process of developing technological remedies in TEDs.

Two primary modifications were tested - one soft TED modification and one hard TED modification. Catch comparisons were conducted between nets fitted with standard TEDs (controls) and modified TEDs (treatments). The two TED types analyzed were the Morrison TED and the Super-Shooter style hard TED.

Tests were conducted by towing the two pairs of TEDs simultaneously in side-by-side trawling with the commercial shrimp fleet. Analyses of initial tows and subsequent submersible video observations indicated a possible problem in the soft TEDs; therefore the soft TEDs were reinstalled in the middle of the project.

While the hard TEDs appeared to function properly throughout this work, a great deal of force was needed to stretch the webbing sufficient to meet the new escape opening specifications cited in the Federal Register.

GRANT NUMBER: NA57FD0033 (Cont'd.)

Nevertheless, the tows were conducted over the course of an entire shrimping season, and the data indicate that a large escape hole could be an acceptable and commercially viable option.

The predominant species of finfish that make up the vast majority of finfish weight had reduction rates similar to those of the standard TEDs. These species include: the Atlantic menhaden, Atlantic spot, Atlantic croaker, and southern kingfish. In addition, the soft TED showed a marked effectiveness at finfish bycatch reduction.

GRANT NUMBER: NA57FD0067 NMFS NUMBER: 93-SER-060
REPORT TITLE: An Expansion of Observer Program to Characterize
and Compare the Southeast U.S. Directed Shark
Fishery to Include the East Coast of Florida
AUTHOR: Branstetter, Steve; Gulf and South Atlantic
Fisheries Development Foundation
PUBLISH DATE: August 1996
AVAILABLE FROM: National Marine Fisheries Service
Southeast Region
9721 Executive Center Drive, North
Koger Building
St. Petersburg, FL 33702
PHONE: (813) 570-5324

ABSTRACT

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To garner otherwise unobtainable information, and thus enhance the reliability of management strategies, observers aboard voluntarily participating commercial shark vessels documented a sample of the catch and effort of the southeast U.S. commercial shark longline fishery. Specific to this award, one observer monitored the fishery along the Atlantic coast of Florida from January 1995 through May 1996. During that time, he logged 97 sea days, and monitored 107 longline sets during 30 fishing trips. More important, this effort extended coverage of a region-wide survey. Since 1994, three observers have logged 460 sea days monitoring 365 longline sets during 127 fishing trips. Approximately 3,700,000 hook-hours of effort produced over 15,000 sharks of 27 different species; this translated to about 153 metric tons of landings (2.4% of the U.S. commercial shark landings for the period). Two species, blacktip sharks (*Carcharhinus limbatus*), common inshore of the 10 fathom contour, and sandbar sharks (*Carcharhinus plumbeus*), dominant in deeper continental shelf waters, constituted 60-75% of the catch and 75-95% of the landings. Between 15-20% of the large-coastal shark catch was released, and some non-documented mortality catch (catch that is used for bait or discarded) occurred in the fishery; landings accounted for approximately 90% of the total mortality on this stock. Nearly 100% of the small-coastal shark catch (dominated by the Atlantic sharpnose shark, *Rhizoprionodon terraenovae*) was landed or used for bait. Within a region, catch rates between years and seasons were, for the most part, not statistically different. For all regions combined, approximately 50% of the documented catch of sandbar and blacktip sharks was immature. Small sandbar sharks were more common inshore of the 10-15 fathom depth range, especially off North Carolina. Almost all blacktip sharks were taken in shallower (<10 fm) waters. Given the short term nature of this database (2.5 yr), no conclusive trends can be determined concerning the health of the shark stock, but because much of the catch inside 10-15 fathoms is immature fish, and during the spring include pregnant females,

GRANT NUMBER: NA57FD0067 (Cont'd.)

continued fishing pressure in nearshore (< 10 fm) waters may have substantial negative impacts on the stock; to the long-term detriment of the stock and fishery. Reduction of fishing effort, either through size limits or area-season closures should reduce mortality on these younger cohorts, thus enhancing stock recovery.

GRANT NUMBER: NA57FD0068 NMFS NUMBER: 93-SER-042
REPORT TITLE: Molecular Genetic Analysis of White Marlin
Population Structure
AUTHOR: Graves, John E.
PUBLISH DATE: October 1, 1996
AVAILABLE FROM: National Marine Fisheries Service
Southeast Region
9721 Executive Center Drive, North
Koger Building
St. Petersburg, FL 33702
PHONE: (813) 570-5324

ABSTRACT

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The population genetic structure of white marlin (*Tetrapturus albidus*) was investigated with restriction fragment length polymorphism (RFLP) analysis of mitochondrial (mt) DNA. The technique revealed substantial variation within samples of white marlin from the U.S. mid-Atlantic coast, Caribbean, southern Brazil and Morocco. Collections of white marlin from the same geographic location taken in different years were not significantly heterogeneous, allowing temporal samples to be pooled for analyses of homogeneity among geographic locations. The distributions of mtDNA haplotypes among relatively large samples (36-76 individuals) of white marlin from four sampling locations was not significantly different ($p=0.06$), although it was noted that the probability of homogeneity decreased as sample sizes increased. At this time the null hypothesis of a total Atlantic stock of white marlin, a model which is also supported by observations on the distribution, spawning, and movements of the species, cannot be rejected. However, there appear to be some restrictions to gene flow (exchange), with a greater impediment to gene flow across the Atlantic (east/west) than across the equator (north/south).

GRANT NUMBER: NA57FD0069 NMFS NUMBER: 93-SER-002
REPORT TITLE: Genetic Studies to Determine Stock Structure of
Greater Amberjack in the Gulf of Mexico and
Southeastern (U.S) Atlantic Ocean
AUTHOR: Gold, Dr. John R.
PUBLISH DATE: December 12, 1997
AVAILABLE FROM: National Marine Fisheries Service
9721 Executive Center Drive, North
Koger Building
St. Petersburg, FL 33702
PHONE: (813) 570-5324

ABSTRACT

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Appropriate tissues were obtained between 1994 and 1996 from 444 greater amberjack (*Seriola dummerili*) sampled from 11 offshore localities in the northern Gulf of Mexico (Gulf) and along the U.S. southeast Atlantic coast (Atlantic). Restriction sites of mitochondrial (mt) DNA from each individual were surveyed by using a battery of 16 type-II restriction enzymes. A total of 49 mtDNA haplotypes (genotypes) were detected. Percent nucleotide-sequence divergence among the haplotypes ranged from 0.156 to 2.623 (mean + S.E.=0.980+ 0.015). Nucleon diversity within samples ranged from 0.845 to 0.906, and intrapopulational mtDNA diversities ranged (mean+ S.D.) from 0.483+0.370 to 0.619+ 0.419. The latter did not differ significantly from one another.

GRANT NUMBER: NA57FD0130 NMFS NUMBER: 93-SER-049
REPORT TITLE: Skimmer Trawl Modifications to Reduce Bycatch in
the Inshore Brown and Pink Shrimp Fishery in
North Carolina
AUTHOR: Hines, Kenneth L. and Rulifson, Roger A.;
Institute for Coastal and Marine Resources
Murray, James D. and Hines, Bob; NC Sea Grant
Marine Advisory Service
PUBLISH DATE: May 1996
AVAILABLE FROM: National Marine Fisheries Service
Cooperative Programs Division
9721 Executive Center Drive North
St. Petersburg, FL 33702
PHONE: (813) 570-5364

ABSTRACT

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The objective of this project was to design, build, and test a low profile skimmer trawl, and compare its performance to a standard sized skimmer trawl for amount of catch, species composition, and size of bycatch. Catch composition of a standard high profile skimmer trawl net (12 ft.) and a low profile skimmer trawl net (3 ft.) in the North and Newport Rivers, North Carolina were compared. Each gear type was alternately rigged on the port and starboard sides of a commercial shrimping vessel and the catches were sampled according to criteria established by the Southeast Area Monitoring and Assessment Program, to determine if modifying skimmer trawl nets by decreasing the vertical height of the net would lower bycatch rates, yet maintain shrimp catch. Total shrimp catch in the low profile net was significantly lower than that in the control net (-32.9%, $p=0.0001$), and significantly lower for brown shrimp (*Penaeus aztecus*) by -39.1% ($p=0.0001$), but pink shrimp (*P. duorarum*) catches were not significantly different (-17.1%, $p=0.1934$). In the sample, weight of finfish biomass to total catch biomass, excluding debris, was similar (47.5% finfish in the low profile net and 44.8% finfish in the high profile net). The low profile net was not effective in reducing bycatch under most conditions. Because of the increased catch rates of brown shrimp by the high profile net, results suggest that shrimpers may find it advantageous to utilize a high profile skimmer net during the brown and pink shrimp seasons, rather than a low profile net. The low profile net may be advantageous to fishermen under conditions of high wind, shrimping in areas where tight turns are mandated, presence of large amounts of floating debris, and shallow water.

GRANT NUMBER: NA57FD0131 NMFS NUMBER: 93-SER-017
REPORT TITLE: Assessment of Composition and Magnitude of
Bycatch Associated with the Commercial Shrimp
Trawling Industry on the Northern and Mid-Texas
Coast during the 1995 Spring and Fall Texas
Commercial Bay Shrimp Open Seasons
AUTHOR: Fuls, Billy
PUBLISH DATE: August 30, 1996
AVAILABLE FROM: National Marine Fisheries Service
9721 Executive Center Drive, North
St. Petersburg, FL 33702
PHONE: (813) 570-5324

ABSTRACT

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The project had four major goals and objectives. (1) To determine percent composition by weight and number of target species (shrimp) and all non-target species caught in commercial shrimp trawls within bays on the northern and mid-Texas coast. (2) To determine the catch rate and mean size of target and non-target species. (3) To compare average percent composition of commercial bay trawl species to species composition in the Texas Parks and Wildlife Department's (TPWD) fishery independent bay trawl surveys; and , (4) to compare 1995 bycatch composition and magnitude on the northern and mid-Texas coast during the 1995 spring and fall shrimping seasons to preliminary single-year bycatch data collected during 1992 in Galveston Bay and during 1993 in Corpus Christi Bay.

This project determined percent composition, catch rate and mean size of commercial shrimp seasons in Galveston Bay, Matagorda Bay, San Antonio Bay and Corpus Christi Bay. It also conducted statistical analyses on percent composition of major commercial shrimp and bycatch organisms collected in commercial and TPWD samples during the spring and fall shrimping seasons on the northern and mid-Texas coast. This knowledge will assist in the management of Gulf of Mexico recreational and commercial marine organisms and associated fisheries, as well as in environmental issues and management regimes related to Texas Bay and Gulf of Mexico ecosystems.

GRANT NUMBER: NA57FD0261 NMFS NUMBER: 93-SER-059
REPORT TITLE: Final Implementation of High-Priority Objectives
of a Bycatch Reduction Research Program for the
Gulf of Mexico and South Atlantic Shrimp Fishery
AUTHOR: Branstetter, Steve; Gulf and South Atlantic
Fisheries Development Foundation, Inc.
PUBLISH DATE: May 6, 1997
AVAILABLE FROM: National Marine Fisheries Service
Southeast Regional Office
9721 Executive Center Drive North
St. Petersburg, FL 33702
PHONE: (813) 570-5364

ABSTRACT

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This award completed involvement of the Gulf and South Atlantic Fisheries Development Foundation, Inc. in a multi-organizational multi-year research program to address bycatch in the shrimp fishery of the southeastern U.S. Primarily, this award supported continued at-sea data collection by observers and Foundation efforts to disseminate information about bycatch and its reduction to interested and affected parties. During this award, observers logged 589 sea-days on 36 sampling trips in southeast U.S. waters aboard 10 different participating commercial shrimp trawlers. The catch in 671 paired tows was evaluated for the exclusion capability of various experimental devices, or the exclusion of various TEDs; additionally a minimal 3 tows were sampled characterizing the catch of the South Atlantic rock shrimp fishery. This effort contributed to a 1993-1996 Foundation-generated database of 3,166 tows (55% of the programmatic database). Since the Bycatch Program began, a wide variety of types and configurations of bycatch-reduction-devices (BRDs) have been tested by this organization, and others. Previous research has documented that two general categories of bycatch reduction devices [BRDs] (*fisheyes* and *expanded mesh*) can be used to excluded substantial numbers and weight of finfish without concurrent substantial shrimp loss.

GRANT NUMBER: NA66FD0011 NMFS NUMBER: 95-NER-009
REPORT TITLE: A Size Selective, Near-Zero Mortality Trawl for
Silver Hake
AUTHOR: Amaru, William Hugo
PUBLISH DATE: December 1996
AVAILABLE FROM: National Marine Fisheries Service
Northeast Region
One Blackburn Drive
Gloucester, MA 01930-2298
PHONE: (978) 281-9267

ABSTRACT

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Any mesh used in New England to capture regulated species in the regulated mesh area of the federal EEZ less than the present 6" regulated minimum, must result in the capture of regulated species not in excess of 5% of the total when measured by weight. This requirement has rendered the use of small mesh bottom trawls historically used to capture silver hake (*Merluccius bilinearis*) illegal in all but a small part of the regulated mesh zone. To allow a fishery for silver hake to continue under the new regulations, a stipulation permitting a modified small mesh net was introduced, based on the proven success and acceptance of the Nordmore grate* in the Northern U.S. shrimp fishery. It called for the use of the grate with 40mm. spacing between the bars and the limited use of ground gear between the net and doors this combination held out some hope that a silver hake fishery could continue, little use of the new configuration is taking place. The difficulties encountered in correctly installing and using the grate are problematic. It is more difficult to use for a strong swimming fin fish like silver hake, which actively seeks to escape from the net. Also, the largest silver hake cannot be taken because the narrow (40mm. or about 1 5/8") openings in the grate exclude not only regulated species but larger silver hake from capture in the codend. Goals of this project were to develop a net and grate separation system which together allow larger silver hake to be retained while maintaining a <5% by-catch level, and to encourage pre-spawning and less valuable small whiting minimal stress when escaping the net. A 45mm. grate opening was used and 15 fathoms of ground gear were added to the 15 fathom leg system. Square mesh was placed in varying configurations in the body of the net and the codend to encourage easy escapement for juvenile fish. Research results were presented to various audiences. Videographic details of fish behavior were recorded.

GRANT NUMBER: NA66FD0014 NMFS NUMBER: 95-NER-050
REPORT TITLE: An Investigation and Development of Active
Acoustic Deterrent for Harbor Porpoise in the
Gillnet Fishery
AUTHOR: Baldwin, Kenneth C.; Kraus, Scott; and DeRosa,
Elizabeth
PUBLISH DATE: June 6, 1997
AVAILABLE FROM: National Marine Fisheries Service
Northeast Region
One Blackburn Drive
Gloucester, MA 01930-2298
PHONE: (978) 281-9256

ABSTRACT

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The purpose of this work was to find an acoustic signal which will cause avoidance in free-swimming harbor porpoise without habituation and without alerting seals to the presence of gillnets filled with fish. If such a sound could be found, the next generation of pingers for gillnet attachment could be developed to reduce the incidental take of harbor porpoise. In 1996, a total of 112 porpoises were observed during 32 days of sound trials using one type of sound, a 50 kHz ping that occurs at intervals comparable to commercially available pingers. In 1996 weather conditions were vastly better than in 1993 (32 vs. 18 viable working days), but porpoise densities were at an all-time low for the region. These low numbers limited the number of valid trials available for testing, so only one sound type was tried during the seasons. This type of study can be very effective at determining the effects of acoustic signals on free-swimming marine mammals. However, better information on the hearing thresholds of porpoises at different frequencies is critically needed. Otherwise, the uninformed fear that a very low probability event may injure a few individual animals will continue to impede the ability to answer the scientific questions necessary for the truly effective conservation and management of marine mammal populations.

GRANT NUMBER: NA66FD0015 NMFS NUMBER: 95-NER-061
REPORT TITLE: A Symposium: Open-Ocean Aquaculture-"What We
Know, What We Don't Know, What We Need To Know"
AUTHOR: Barnaby, Roland; UNH/UMaine Sea Grant College
Program
PUBLISH DATE: August 1997
AVAILABLE FROM: National Marine Fisheries Service
Northeast Region
One Blackburn Drive
Gloucester, MA 01930
PHONE: (978) 281-9256

ABSTRACT

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An International Conference on Open-Ocean Aquaculture was held May 8-10, 1996 in Portland, Maine. The purpose of the conference was to bring people together from around the world to discuss the issues, problems, and opportunities for aquaculture in the open ocean or high energy environment. The target audiences were aquaculturists, fishermen, marine biologists, fisheries scientists, ocean engineers, community development specialists, environmental regulators, policy-makers, students, planners, investors, and natural resource economists.

The conference was funded by the National Sea Grant College Program as part of a larger finfish aquaculture grant and a National Marine Fisheries Service Saltonstall-Kennedy Program Grant. It was sponsored by the University of New Hampshire/University of Maine Sea Grant College Program, UNH Cooperative Extension, the National Marine Fisheries Service, and the Massachusetts Institute of Technology Sea Grant College Program.

Over 200 people registered for and participated in the conference. Thirty people made presentations. All but three presenters or speakers are represented in the proceedings. A poster/social session held on the first night of the conference featured 26 posters.

GRANT NUMBER: NA66FD0020 NMFS NUMBER: 95-NER-098
REPORT TITLE: Development of a Rapid Non-Destructive Technique
to Measure Fat Content of Mackerel
AUTHOR: McClements, Dr. David Julian
PUBLISH DATE: December 1, 1997
AVAILABLE FROM: National Marine Fisheries Service
Northeast Region
One Blackburn Drive
Gloucester, MA 01930-2298
PHONE: (978) 281-9256

ABSTRACT

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Our objective was to ascertain the relationship between the ultrasonic properties of fish and their composition. Fish analogs with varying protein (15 to 25wt%), lipid (0 to 25 wt%) and moisture (55 to 80 wt%) contents were prepared by mixing dried cod powder, sunflower oil and distilled water. The temperature dependence of the ultrasonic velocity of fish analogs was measured from 5 to 35 C. The ultrasonic velocity increased with solids-non-fat at all temperatures, but had a more complex dependence on fat content. Around 15 C the ultrasonic velocity was independent of fat, at lower temperatures it increased with fat, and at higher temperature it decreased. Empirical equations were developed to relate the ultrasonic velocity to composition. Our results highlight the potential of ultrasonic velocity to composition. Our results highlight the potential of ultrasonic velocity measurements to rapidly and nondestructively determine fish composition.

GRANT NUMBER: NA66FD0021 NMFS NUMBER: 95-NER-104
REPORT TITLE: An Inter-Laboratory Study for the Use of the
Ammonia Electrode to Evaluate Seafood Quality
AUTHOR: Pivarnik, Dr. Lori F. and Ellis, P. Christopher
PUBLISH DATE: October 22, 1997
AVAILABLE FROM: National Marine Fisheries Service
Northeast Region
One Blackburn Drive
Gloucester, MA 01930-2298
PHONE: (978) 281-9256

ABSTRACT

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To enlist eight independent laboratories to jointly evaluate the performance of the ammonia ion-selective electrode as a rapid, simple screening procedure for seafood quality. The protocol guidelines outlined by the Association of Official Analytical Chemists (AOAC) International will be used, and total volatile base and trimethylamine analyses will also be done, where possible. The study will evaluate the success of this technique on fatty fish, in comparison to results of prior work on lean fish flesh. All data will be analyzed statistically.

GRANT NUMBER: NA66FD0042 NMFS NUMBER: 95-AKR-009
REPORT TITLE: Comparison of Three Genetic Methodologies for
Stock Identification of Pink, Chum, and Sockeye
Salmon in the North Pacific (Phase 1)
AUTHOR: Gharrett, A.J.; Gray, A.K.; Churikov, D.;
Matsuoka, M.P.; Luan, X.; and Brykov, V.
PUBLISH DATE: March 31, 1997
AVAILABLE FROM: National Marine Fisheries Service
P.O. Box 21668
Juneau, Alaska 99802-1668
PHONE: (907) 586-7280

ABSTRACT

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Genetic variation is routinely used to identify origins of salmon caught in mixed fisheries, intercepted by foreign fisheries, and taken as bycatch in fisheries directed at other species. Historically protein electrophoresis has been the primary tool, but the method has some drawbacks, such a limitation on the scope of the genetic variability resolved and requirement for quality tissue samples that often necessitates use of liquid nitrogen or dry ice the field. DNA-based methods offer opportunity for exposing much more genetic variation and have less rigorous requirements for sample quality. Here we describe the work we have conducted to determine the genetic markers we will use to acquire genetic data from and compare the nature of the genetic variation in populations of chum, sockeye, and both even-and odd-broodyear pink salmon. In this preliminary study, we screened subsamples of populations of those species for variation in mitochondrial DNA sequences and for variation at nuclear microsatellite DNA loci. The geographic distribution of samples screened spans the North Pacific Ocean from southern Southeast Alaska to Asia. Substantial mtDNA variation was resolved for all species and three variable microsatellite loci were found for each species. These results will be used to select markers that will be evaluated in larger sample sizes from more numerous populations in the next phase of the project. At the end of the project, variation resolved using both DNA-based and data from protein electrophoresis, parallel data sets from the same individual fish, will be compared and evaluated for their performance to detect stock structure.

GRANT NUMBER: NA66FD0044 NMFS NUMBER: 95-AKR-003
REPORT TITLE: Nori Cultivation: Physiological Ecology of
Native Alaskan Porphyra Species
AUTHOR: Stekoll, Michael S. and Lindstrom, Sandra C.
PUBLISH DATE: March 3, 1997
AVAILABLE FROM: National Marine Fisheries Service
Alaska Region
709 W. 9th Street, 4th Floor
P.O. Box 21668
Juneau, AK 99801
PHONE: (907) 586-7280

ABSTRACT

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Research was carried out on the physiological ecology of species of *Porphyra* from southeast Alaska. Species were collected from various field sites near Juneau, Sitka, Metlakatla and Kachemak Bay. Conchocelis cultures were started and maintained as both free and shell cultures. Environmental conditions for conchocelis maturation and spore release were investigated. Growth experiments were carried out on the microscopic conchocelis phase of three species. Multi-factorial experiments assessed the interactive effects of light intensity, salinity and temperature on growth. Preliminary experiments that investigated the effects of light intensity, salinity, temperature and nutrients on the growth of young *Porphyra torta* blades were performed. *Porphyra torta* was outplanted during the summer and fall. Some efforts were made for outreach and technology transfer with Alaskan native organizations. It is anticipated that the project will require at least an additional year of work before objectives are met.

GRANT NUMBER: NA66FD0046 NMFS NUMBER: 95-AKR-012
REPORT TITLE: Electromagnetic Sensor for Automatic Detection
of Parasites in Fish
AUTHOR: Choudhury, G.; Bublitz, C.G.; Jenks, W.G.;
Ammons, D.E.; and Wikswo, Jr., J.P.
PUBLISH DATE: May 29, 1997
AVAILABLE FROM: National Marine Fisheries Service
P.O. Box 21668
Juneau, AK 99802-1668
PHONE: (907) 586-7280

ABSTRACT

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Candling, the traditional means of detecting parasites during fish fillet processing, is time consuming and labor intensive. This method is a major factor in reducing the quality and increasing the cost of fish brought to market. The difference in electrical conductivity between fish and an embedded parasite was hypothesized to provide a practical basis for an instrument, which would have potential for automated parasite detection. In a previous experiment, a small electrical current was passed through a parasite-containing fillet and the magnetic field above the fillet was recorded by a Superconducting Quantum Interference Device (SQUID) magnetometer. The results indicated that the technique had promise as a means to detect parasites in an automated configuration. It was shown that the magnetic signature of a single parasite embedded in a small fillet could be detected under particular conditions. Here we report on an extension of that work which extends the experimental parameters into various frequency and signal regimes. It is shown here that the signal of interest is independent of the frequency of the injected current up to 2000 Hz and that the magnitude of the signal scales with current amplitude.

GRANT NUMBER: NA66FD0049 NMFS NUMBER: 95-AKR-025
REPORT TITLE: Size-Specific Spatial Dynamics of Pacific
Halibut: A Key to Reduce Bycatch in the
Groundfish Fisheries
AUTHOR: Adlerstein, Sara A. and Trumble, Robert J.
PUBLISH DATE: March 1997
AVAILABLE FROM: National Marine Fisheries Service
P.O. Box 21668
Juneau, AK 99802-1668
PHONE: (907) 586-7280

ABSTRACT

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The goal of the project was to provide a prediction of relative Pacific halibut bycatch rates in groundfish fisheries of the Bering Sea and Gulf of Alaska, using distribution of halibut size classes and patterns of groundfish harvest, as a means of reducing halibut bycatch.

The following passage was taken from the project's final report... It was determined that halibut year class strength (numbers and biomass) varies by an order of magnitude. CPUE of each size group will change dramatically as strong and weak year classes pass through, which will cause bycatch rates to vary year by year. Additionally, the proportion of halibut that could be protected by closing any Bering Sea area of concentration, however, may be fairly small, as Clark and Walters (1997) show that halibut sampled by trawl surveys are typically more abundant in the Gulf of Alaska than in the Bering Sea. It was concluded that the best use of this data set is by fishermen voluntarily adjusting the fishing pattern to harvest groundfish with a minimum of halibut bycatch. Mandatory time-area management would inevitably have some closure occurring where halibut are in relatively low abundance, while allowing fishing in areas of high halibut concentration.

GRANT NUMBER: NA66FD0091 NMFS NUMBER: 95-WO-016
REPORT TITLE: Putrescine/Cadaverine Dipstick Test for
Decomposition in Fisheries Products
AUTHOR: Hall, Dr. Margo
PUBLISH DATE: November 24, 1997
AVAILABLE FROM: National Marine Fisheries Service
Southeast Region
3209 Frederic Street
PO Drawer 1207
Pascagoula, MS 39568
PHONE: (601) 769-8964

ABSTRACT

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A colorimetric enzyme based dipstick assay method was developed for detection putrescine, cadaverine, and histamine in decomposing tuna samples. The color developed was proportional to the amine concentration. The assay reacted strongly with all three amines but there was a preference for putrescine and cadaverine over histamine. It was equally specific for putrescine and cadaverine.

GRANT NUMBER: NA66FD0102 NMFS NUMBER: 95-NWR-020
REPORT TITLE: Fish Kills Associated with *Heterosigma* Surface
Blooms
AUTHOR: Taub, Freida B.; University of Washington
PUBLISH DATE: March 27, 1997
AVAILABLE FROM: National Marine Fisheries Service
Northwest Regional Office
7600 Sand Point Way, NE
Seattle, WA 98115
PHONE: (206) 526-6115

ABSTRACT

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In this laboratory, Jose R. Carraquero demonstrated that toxicity could be expressed to salmonids only if the *Heterosigma* were cultured under longer light period than 12 hours light: 12 hours dark, and only if cultured in an enriched sea water medium (HESNW), but not if cultured in O-3, a highly enriched chemically defined medium that we had used for most of our studies. When grown with continuous light and in HESNW medium, *Heterosigma* grown with bacteria (an algal-bacteria-consortium, ABC, obtained from Drs. Albright and Yang of the Department of Biological Sciences, Simon Fraser University, Burnaby, BC, Canada) was toxic to salmonids (chinook, *Oncorhynchus tshawytscha*, coho, *O. kisutch*, and rainbow trout, *O. mykiss*). Neither supernatant nor the bacteria were themselves toxic. Axenic cultures of Man-1 became toxic when grown with bacteria from ABC or when grown with either of two types of non-toxic bacteria. Deaths occurred more rapidly when cultures were grown and fish exposed at 20 C than at 12 C. The toxic cultures produced superoxide radicals, as measured by a luminol reaction, a measure of superoxide radicals. Addition of Vitamin C, eliminated the luminol reaction, but did not prevent mortality. The addition of a catalase in addition to Vitamin C did eliminate mortality. This suggests that hydroxyl radicals may have been responsible for the mortalities, but the role of superoxide, in the absence of Vitamin C addition, cannot be eliminated. These data lend strong support to the hypothesis that free radicals or Reactive Oxygen Species (ROS) are involved in the mortality, but cannot exclude the potential of other toxic factors being present. Salmonids exposed to ABC or Man-1 with bacteria behaved as if anesthetized. Histological examination of the gills of exposed fish showed edema and a considerable degree of epithelial separation from the capillary core of the second lamellae. This could have caused death by hypoxia by decreasing oxygen and carbon dioxide exchange.

Exposure of Man-1 *Heterosigma* grown in HESNW to 4 hours of light intensity including UV-B did not result in toxicity to salmonids. The algal cultures were not exposed to UV during the fish exposures. During the exposure period, the light intensities were (in W/m(squared)) in the treatment (PAR=8.3, UV-A=2.8, and

GRANT NUMBER: NA66FD0102

0.1) as compared to the controls (PAR=8.2, UV-A=2.5, and 0.002). These values are only about 2-3% of full sunlight. Luminol reactions showed no superoxide radicals.

GRANT NUMBER: NA66FD0105 NMFS NUMBER: 95-NWR-028
REPORT TITLE: Evaluation of Electronic Detection for Coded-
Wire Tags in Salmon from Commercial, Sport and
Hatchery Rack Sampling Programs
AUTHOR: Blankenship, Lee; Washington Department of Fish
and Wildlife
PUBLISH DATE: March 1997
AVAILABLE FROM: National Marine Fisheries Service
Northwest Regional Office
7600 Sand Point Way, NE
Seattle, WA 98115
PHONE: (206) 526-6115

ABSTRACT

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Mass marking adipose fins of hatchery coho salmon (*Oncorhynchus kisutch*) has been proposed as a tool to allow selective harvest fish while reducing exploitation of unmarked wild stocks. The adipose fin mark has historically been used as an indicator for the presence of an internal coded-wire tag (CWT). To maintain the viability of the CWT system as a management tool with mass marking adipose fins, the Pacific Salmon Commission (PSC) recommended that electronic detection be used to identify fish with CWT's. This project was designed to test and determine the reliability, feasibility, and staffing requirements of sampling for CWT's with electronic detection. Two types of electronic detectors were tested: a hand-held unit (wand) and a stationary unit containing a fish passage tube (R-8 tube). The wands and R-8 tube detectors reliably detected CWT's in coho salmon at rates at least as good as believed possible by visual detection. Although feasible, electronic detection requires a significant increase in sampling time and effort when compared to the visual method. Improvements in design by the manufacturer of the electronic detection equipment are expected to increase its reliability and feasibility.

The "Evaluation of Electronic Detection for Coded-Wire Tags in Salmon from Commercial, Sport and Hatchery Rack Sampling Programs" project, funded by the Saltonstall-Kennedy grant funds, was a joint effort between the Washington Department of Fish and Wildlife (WDFW) and the Northwest Indian Fisheries Commission. This project served as a catalyst for a larger and more comprehensive project which also included the Canada Department of Fisheries and Oceans. This international effort provided a broader scope analysis of electronic detection than was possible by the S-K project alone. This group was designated by the PSC Selective Fishery Evaluation Committee as a formal Electronic Detection Work Group. This work group wrote an executive summary and presented its findings to the PSC. The executive summary is attached as well as the individual reports from each participating agency. Although not part of the reporting requirement for this S-K project, the combined executive summary

GRANT NUMBER: NA66FD0105 (Cont'd.)

and other agency reports are attached to provide a more comprehensive and informative report. The individual agency and fishery reports provide detailed descriptions of the "Approach" and "Findings".

GRANT NUMBER: NA67FD0009 NMFS NUMBER: 95-NER-005
REPORT TITLE: Oceanic Squid Fishery
AUTHOR: Smolowitz, Ronald
PUBLISH DATE: January 27, 1996
AVAILABLE FROM: National Marine Fisheries Service
Northeast Region
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ABSTRACT

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The F/V *Perseverance* was converted to conduct exploratory squid jigging operations. Conversion consisted of installing a light platform with an array of lights, a small electric generating system, and four jigging machines, two fully automatic and two manual. A total of 65 jigging stations were occupied between September and November 1996. On 80% of the stations occupied under good observing conditions off the shelf-slope, the oceanic neon flying squid, *Ommastrephes bartramii*, was observed or caught. A total of 141 neon flying squid were caught and specimens sent to the NMFS Systematics lab at the Smithsonian and to potential buyers. A detailed literature search was conducted on the neon flying squid, but little was found about its distribution and ecology in the Northwest Atlantic. Even though the catches made during this project would seem too low to predict commercial potential, quite a few of these squid were observed. Surveys earlier in the season and at greater depths should be undertaken.

GRANT NUMBER: NA67FD0031 NMFS NUMBER: 95-SER-010
REPORT TITLE: A Cooperative Interstate Study to Evaluate Non-
Reporting Rate of Recreational Anglers Who
Capture Tagged Red Drum
AUTHOR: Smith, Theodore I.J., and Woodward, Arnold G.
PUBLISH DATE: September 1997
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ABSTRACT

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The non-reporting levels of tagged red drum, (*Sciaenops ocellatus*) captured by recreational anglers in two estuaries, one in Georgia and one in South Carolina, were evaluated using two tag reward messages: Reward and \$100 Reward. The Reward inscribed message is the standard message used in fishery dependent tagging programs in the southeast, U.S. Equal numbers of legal size fish (356 mm TL) were tagged with either reward message and released into ten locations in SC and GA. A total of 1,500 fish have been stocked to date. Data from the three stockings within the Charleston Harbor estuary, SC and from the three stockings in St. Simons Sound, GA have been analyzed. The data from the final releases will be available in 1998. The main assumption was that a \$100 Reward would be adequate incentive to assure 100% reporting of captured tagged fish and that the difference between "\$100 Reward" and "Reward" tags would yield the non-reporting level. Overall return level to date for all tagged fish in South Carolina was 24.4+1.4%, significantly higher than that reported in Georgia 16.5+1.5%. Using all data no significant differences were detected between Reward tags (22.7+0.8%) and \$100 Reward tags (26.2+2.5%) in SC. In GA, 18.7+2.3% of \$100 reward tags were reported, which was not significantly different from Reward tags (14.4+1.0%). Non-reporting estimates ranged from 0-44% which are lower than the 50% value commonly used by managers. However, analysis of this first data set suggests that the non-reporting level is not statistically identifiable. Inclusion of reporting data from the final stockings (2 estuaries with 3 stockings/estuary) will allow a more robust interpretation of the non-reporting levels for anglers who captured tagged red drum in SC and GA.

GRANT NUMBER: NA67FD0032 NMFS NUMBER: 95-SER-011
REPORT TITLE: Bycatch of Atlantic and Shortnose Sturgeons in
the South Carolina Shad Fishery
AUTHOR: Collins, Mark R. and Smith, Theodore I.J.
PUBLISH DATE: September 1996
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ABSTRACT

Information on incidental capture of shortnose sturgeons, *Acispenser brevirostrum*, and Atlantic sturgeons, *A. oxyrhynchus*, in commercial fisheries was derived from four studies conducted in South Carolina and Georgia. In a Georgia study, 97 of 1,534 tagged juvenile Atlantic sturgeons and 12 of 551 tagged shortnose sturgeons were reported recaptured in commercial nets. Gill net fisheries for American shad, *Alosa sapidissima*, accounted for 52% of Atlantic sturgeons and 83% of shortnose sturgeons recaptured, and the trawl fishery for shrimp, *Penaeus spp.*, was responsible for 39% of Atlantic sturgeon and 8% of shortnose sturgeon recaptured. In the other three studies, catch-per-unit-effort estimates for the American shad gill net fishery varied from 0.003 to 0.137 sturgeons per 91.4 m of gill net per hour.

Most Atlantic sturgeons were less than 150 cm in total length (juveniles), and most shortnose sturgeons exceeded 55 cm in total length (mature or nearly so). The ration of shortnose to Atlantic sturgeons in the shad fishery bycatch increased with inland distance form the ocean. In a South Carolina study, 16% of 51 sturgeons captured incidentally in gill nets died outright and another 20% were injured.

GRANT NUMBER: NA67FD0034 NMFS NUMBER: 95-SER-021
REPORT TITLE: Degradability of Natural Materials Used to
Attach Escapement Panels to Blue Crab Traps in
Texas
AUTHOR: Shively, J. Dale
PUBLISH DATE: February 28, 1997
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ABSTRACT

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Mortality of blue crabs associated with "ghost" fishing traps in the recreational and commercial fisheries is a problem of increasing concern to fisheries managers, commercial fishermen, and environmental groups. Degradability (days-to-breaking) of four binding materials (jute, heavy duty cotton, cotton cable, and medium weight cotton) used in the construction of escapement panels and attachment loops for lid tie-down straps in Texas coastal waters were monitored for a 17 month period. Jute and sisal materials had lower days to breaking than the cotton materials. Their use is recommended to reduce the effects of ghost fishing by abandoned traps in Texas coastal waters.

GRANT NUMBER: NA67FD0039 NMFS NUMBER: 95-SER-056
REPORT TITLE: Development of Cost-Effective Low-Pollution
Feeds for Marine Species
AUTHOR: Davis, D.A. and Arnold, C.R.
PUBLISH DATE: August 1997
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ABSTRACT

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This work was designed to advance environmentally sound aquaculture through the development of low-pollution feeds for the commercial production of *Sciaenops ocellatus* and *Penaeus vannamei*. The first approach sought to reduce waste production by enhancing digestion of feed ingredients. This research evaluated two feed supplements (a protease and an acidifying agent with pro-biotic properties) for their effect on apparent protein digestibility (APD) values for *Sciaenops ocellatus* and *Penaeus vannamei*. Although the responses were different, protein digestibility values were increase by 6.7 and 12.7% through the addition of an acidifying agent in fish feeds and the protease in shrimp feeds, respectively. The second approach was to optimize the lipid component of a previously developed nutrient dense diet, designed for *Sciaenops ocellatus* juveniles, and to further optimize nutrient retention and minimize the deposition of intraperitoneal fat. For this research varying levels of menhaden fish oil (MFO) and medium chain triglycerides(MCT) were evaluated as energy sources in a basal diet containing 44% protein and 5.7% lipid. The supplementation of an additional 3% MFO was required for maximum growth and feed utilization; however, higher levels did not effect growth or feed utilization but facilitated lipid deposition in the fish.

GRANT NUMBER: NA67FD0098 NMFS NUMBER: 95-WO-012
REPORT TITLE: Further Development of a Highly Sensitive Assay
for the Detection of Toxins Responsible for
Diarrhetic Shellfish Poisoning (DSP)
AUTHOR: Honkanen, Richard E.
PUBLISH DATE: May 5, 1997
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ABSTRACT

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This study investigated the development of an enzyme based assay (PP2A-assay) into a rapid and reliable test for the detection of DSP-toxins in shellfish. The PP2A-assay is based on a unique pharmacological property of the major DSP-toxins, okadaic acid (OA) and dinophysistoxin-1 (DTX-1), which bind to and inhibit the activity of certain protein phosphatases (i.e. PP1 and PP2A). Since the harmful effects of OA and DTX-1 originate from their ability to inhibit protein phosphatases, inhibition of PP2A/PP1 activity correlates well with toxicity. The initial step in developing the PP2A assay was to determine the maximal sensitivity and reliability under highly controlled conditions. Studies with pure toxins indicate that the PP2A assay is capable of detecting as little as 10-20 pg of OA or DTX-1. Next, the sensitivity and reliability of the PP2A assay for detecting DSP-toxins in a whole shellfish matrix was assessed with a series of spike recovery experiments. Results from these experiments indicated that the assay was effective at detecting toxins in crude methanol extracts of whole oysters. To further validate the effectiveness of the PP2A assay, a direct comparison was made with a HPLC-based method. Again, the PP2A assay proved to be sensitive and reliable. In an attempt to make the assay more cost effective, we then engineered a clone of PP2A obtained from bovine brain for the production of recombinant PP2A in *E. coli*. We were not satisfied with the yield so we made a chimera, by cloning the N-terminal of PP1 and the toxin binding domain of PP2A "making a hybrid" enzyme called CHRM2. This allowed us to produce a enzyme that could be expressed in large amounts (like PP1) yet still had very high sensitivity to OA (like PP2A). We then assessed methods for optimizing the yield of CHRM2, and repeated the sensitivity and reliability studies to confirm that the chimera was functioning like endogenous PP2A. In conclusion, the PP2A-assay looks promising for development into a reliable method of detecting DSP-toxins in shellfish. The development of a cost effective recombinant enzyme for use in the assay (CHRM2) was an essential step in the development the assay, and this has been accomplished. These studies suggest that further development of the PP2A-assay, if developed to the point where is can be employed, will be a sensitive and reliable test

GRANT NUMBER: NA67FD0098 (Cont'd.)

for the detection of DSP. This should benefit the shellfish industry through the increased consumer confidence provided by a reliable method of toxin monitoring and the general public through improved seafood safety.

GRANT NUMBER: 96-SE-CH NMFS NUMBER:
REPORT TITLE: An Evaluation of Potential Shrimp Virus Impacts
on Cultural Shrimp and Wild Shrimp Populations
in the Gulf of Maine and Southeastern U.S.
Atlantic Coastal Waters
AUTHOR: Shrimp Virus Work Group of the Joint
Subcommittee on Aquaculture
PUBLISH DATE: June 5, 1997
AVAILABLE FROM: National Marine Fisheries Service
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ABSTRACT

The objectives of the project were to identify and address issues that impede ecologically safe expansion of the mariculture industry and to develop technical information to minimize impacts on the environment and on the health of human consumers. Project scientists represented NMFS in various meetings to address issues (national and international) and propose activities in mariculture research and development. Various presentations at international meetings were supported by the project. The project assisted and interagency risk assessment of viruses in Penaeid shrimp. To address a major impediment to the expansion of the industry, i.e., the lack of effective and approved chemotherapeutants, research was initiated to improve drug dosage forms for use in aquatic systems, in collaboration with the Medical University of South Carolina. Two important products of the project are: An Evaluation of Potential Shrimp Virus Impacts on Cultured Shrimp and Wild Shrimp Populations in the Gulf of Mexico and Southeastern Atlantic Coastal Waters (along with numerous other scientists) and Aquatic Therapeutant Delivery Systems (a comprehensive review of literature relevant to chemotherapeutants in aquatic systems).

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